ELECTRICAL REVIEW

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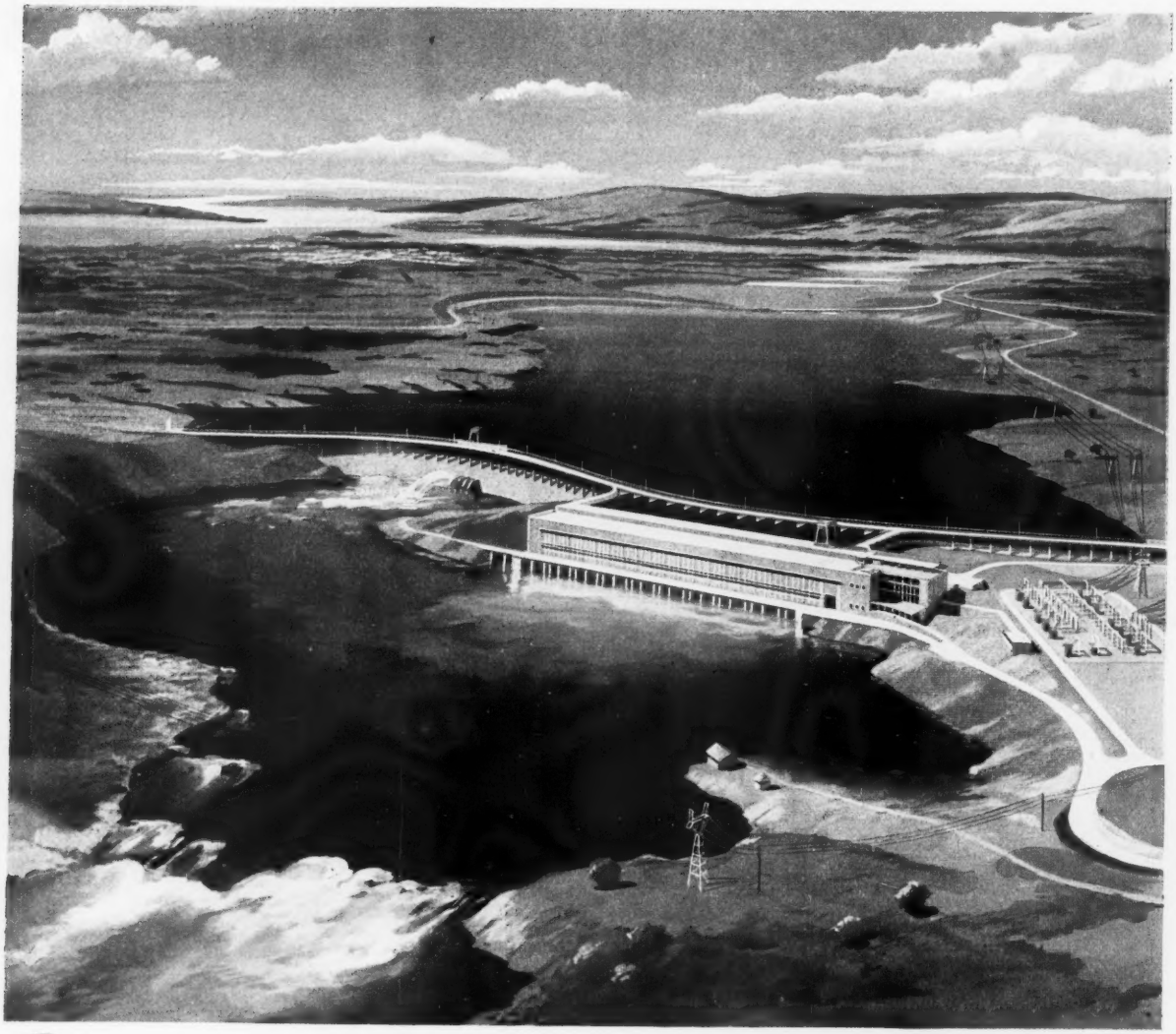
A G.E.C. PRODUCT



The Owen Falls Hydro-electric Scheme will ultimately provide 700 million units of electricity a year, bringing light and power to many parts of East Africa.

The many miles of power, distribution and control cables required for the first four generators of this great scheme were supplied by BICC and installed by the BIC Construction Company — Members of the BICC Group. One hundred and twenty route miles of 132kV overhead line are being erected by the same Company to carry power to Tororo and Kampala.

This contract for the Uganda Electricity Board is typical of the work carried out by the BICC Group in power transmission and distribution, in many parts of the World.

Consulting Engineers: Sir Alexander Gibb & Partners and Messrs. Kennedy & Donkin

BICC

TRANSMISSION EQUIPMENT

at OWEN FALLS

BRITISH INSULATED CALLENDER'S CABLES LIMITED BI Callender's 21 BLOOMSBURY STREET, LONDON, W.C.1

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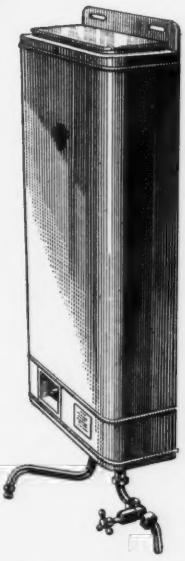
The most difficult requirement can be met by a **Heatrae** *product that has probably been specifically designed for the exact situation.*

The specialised knowledge we have acquired over the years enables us to produce high-quality goods of advanced design and reliable construction.



The **SEB** Water Heater provides a quick supply of hot water under hand control. Ideal for occasional use: lagging and thermostatic control conserve heat and ensure utmost economy.

The **"DOT"** . . . a dependable, economical and safe Electric Water Heater. Specifically designed to fit unobtrusively into any odd corner where space is limited. Neat, attractive, efficient.

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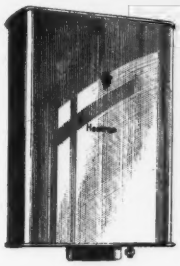
REGISTERED TRADE MARK

HEATRAE PRODUCTS:
Electric Water Heaters, Oil Heaters, Immersion Heaters, Urns, Towel Rails, Airing Cupboard Heaters, Flameproof Heating Apparatus, Breakfast Cookers, Electric Fires, Food Trolleys, Warming Plates, Air Heaters, etc.



Heatrae's **F.B.** Storage-type Heater, a self-contained complete hot water system compacted within minimum dimensions. Operating on lowest current consumption.

The **"Two Twenty."** Nominal water capacity: 20 gallons. Controlled water temperature. Readily accessible covers to working parts. All units interchangeable. Cable entry and control switch well above floor level.

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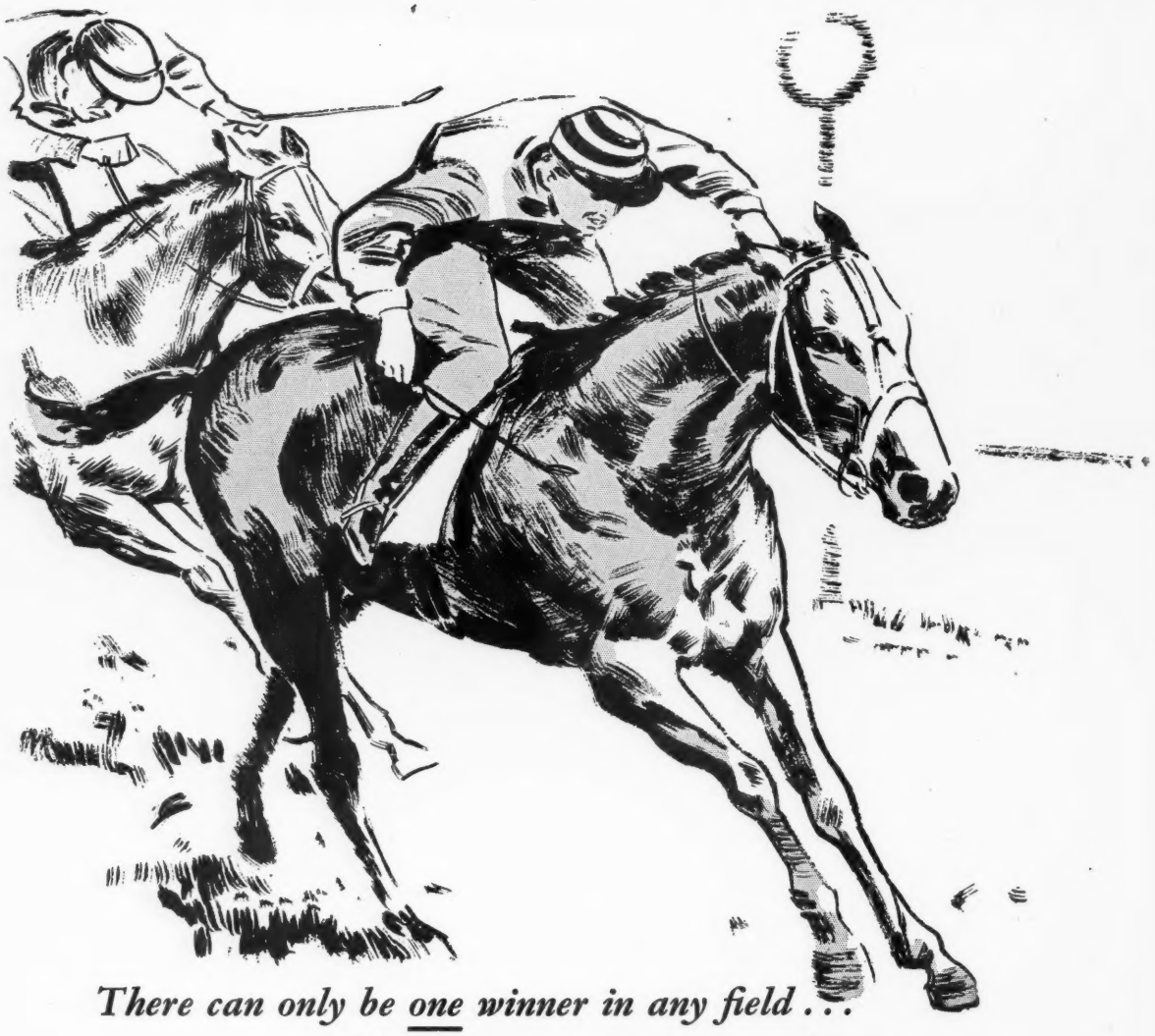

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and Benjamin are way out in front when it comes to fluorescent fittings. The design and construction of our famous 'Crysteel' and 'Peropal' flurolier fittings are backed by years of experience and research in this very specialised field. For efficient power factor correction, minimum stroboscopic effect and lower initial cost, Benjamin Twin Lamp Circuits are recommended.
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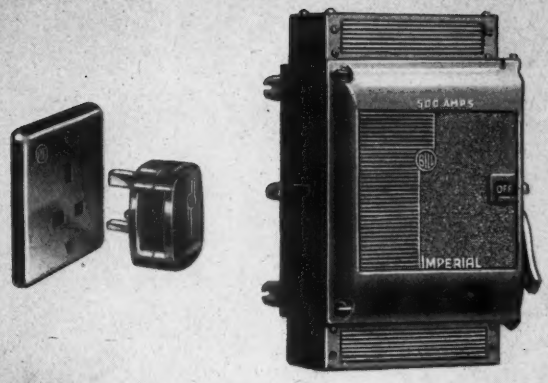

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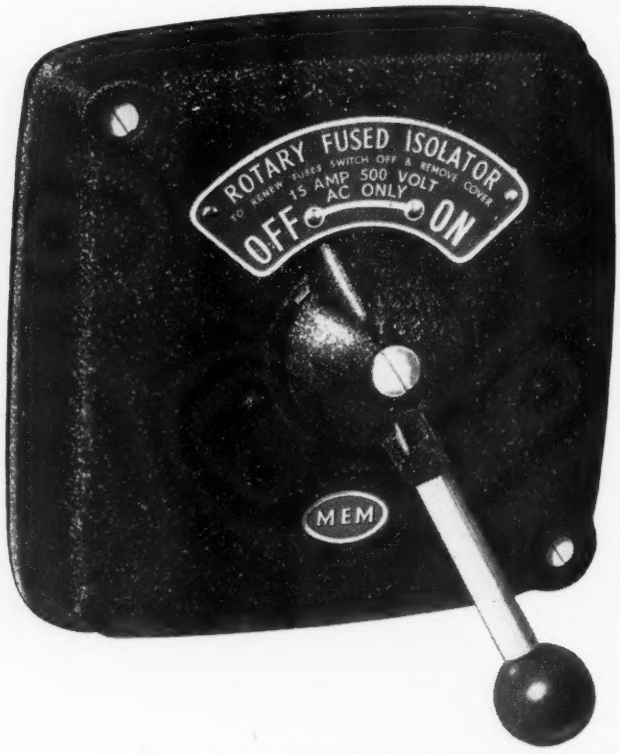
MEM SWITCHCRAFT TAKES A NEW TURN



WITH THE NEW **ROTARY FUSED ISOLATOR**

FOR MACHINE TOOLS AND LIKE APPLICATIONS

The surface mounting pattern has conduit knockouts at top and bottom.

Rated at 15 amps. 500 volts, triple pole for use with A.C. motors up to 7½ H.P. max.

It's a tip-top job from start to finish, worthy in every way to be associated with machine tools and similar equipment of the most refined quality. Compact, yet extremely robust, it has all these plus points of design. And remember only M E M resources can offer such quality at prices so competitive.

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- KANTARK MAJOR rewirable or H.R.C. cartridge fuses are available.
- Interlocked so that cover cannot be removed until switched off.
- Completely safe for fuse renewal. All fuse contacts isolated from supply when cover removed.
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- Finished in handsome black wrinkle enamel.

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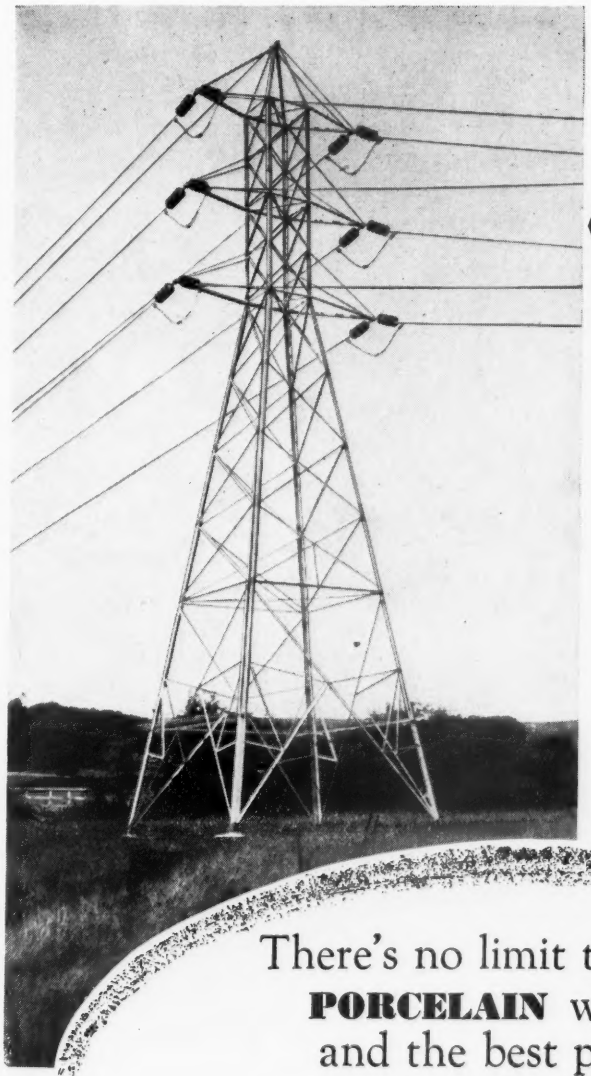

The illustration shows T.T. porcelain Cap and Pin Insulators on one of the first 66 kV Overhead Lines to be erected in the British Isles—a line from Maentwrog to Wrexham which is still in use after more than a quarter of a century.

Taylor Tunnicliff & Co. Ltd. will also supply the Insulators for the latest B.E.A. 275 kV Super Grid Line from Iver via Weybridge to Melksham. (Main Contractors: Balfour Beatty & Co., Ltd., London.)

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PORCELAIN will **LAST**
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USE THE BEST PORCELAIN INSULATORS
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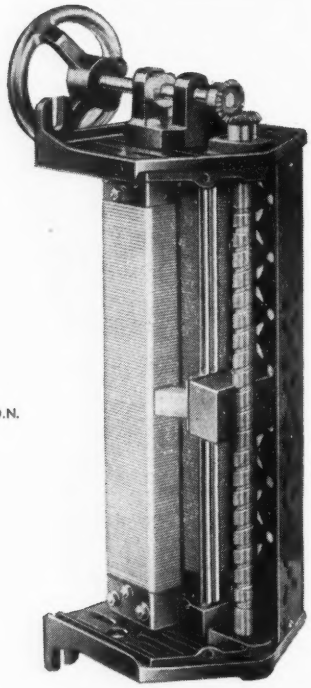
ELECTRICAL RESISTORS *and* HEATING ELEMENTS



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SCREW MOTION
TYPE B.O.B. MODEL D.N.

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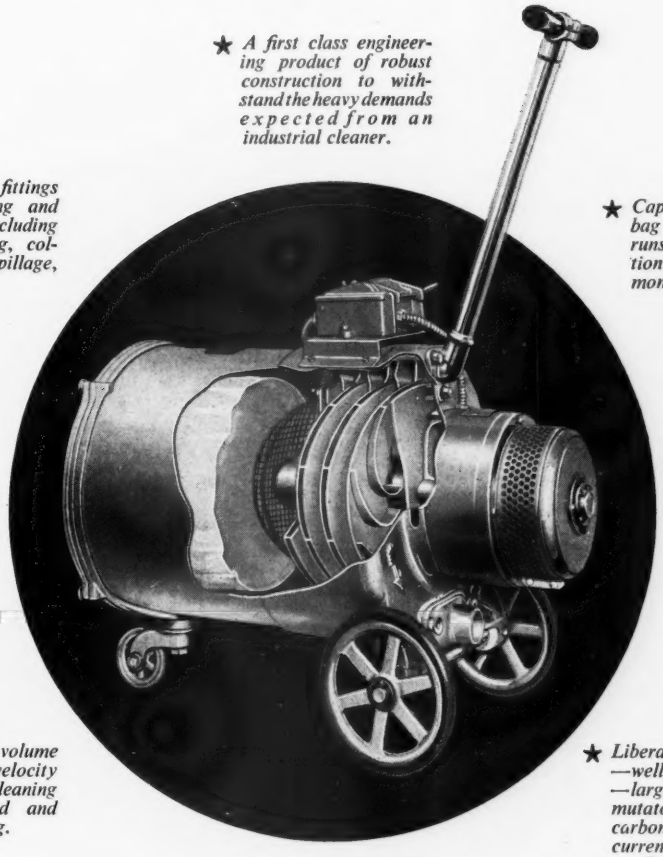
★ *Wide range of fittings for 101 cleaning and blowing tasks, including general cleaning, collection of spillage, swarf, etc.*

★ *Capacious internal filter bag gives long cleaning runs at sustained suction. Removed in a moment for emptying.*



★ *Machine well balanced on sturdy rubber-tyred wheels and castor for negotiating rough surfaces and short radius turns.*

★ *Accurately machined and balanced aluminium die cast impellers and intermediate sections resulting in maximum suction for H.P. absorbed.*

★ *Handles a large volume of air at a high velocity through the cleaning tools for rapid and effective cleaning.*

★ *Liberally rated motors —well wound armatures —large diameter commutator—large section carbon brushes for low current density, and good commutation.*

★ *All motors are D.C. or A.C., 50 periods single phase, 100/110 volts, 200/250 volts, with adjustable brushgear.*

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. . . and you'll buy Sturtevant industrial vacuum cleaners every time. Remember — that during more than 60 years' experience of air handling equipment Sturtevant originated the turbine vacuum cleaner. The range of machines and tools produced by us to-day are the result of years of research and development coupled to the experience gained in supplying thousands of vacuum cleaners to the needs of industry. These machines are not built down to a price! The advantages of this are manifest in the many years' continuous and trouble-free service they give. You will find many applications shown in our illustrated leaflet U.5007A which we shall be happy to send you on request.

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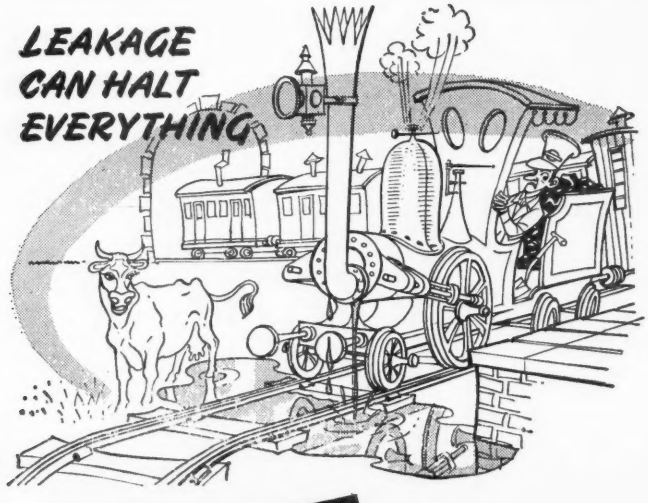

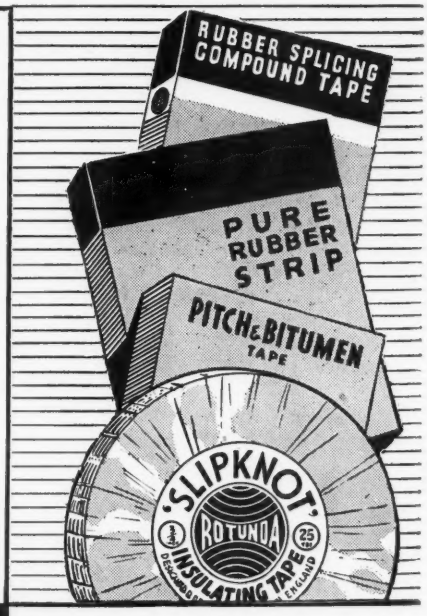

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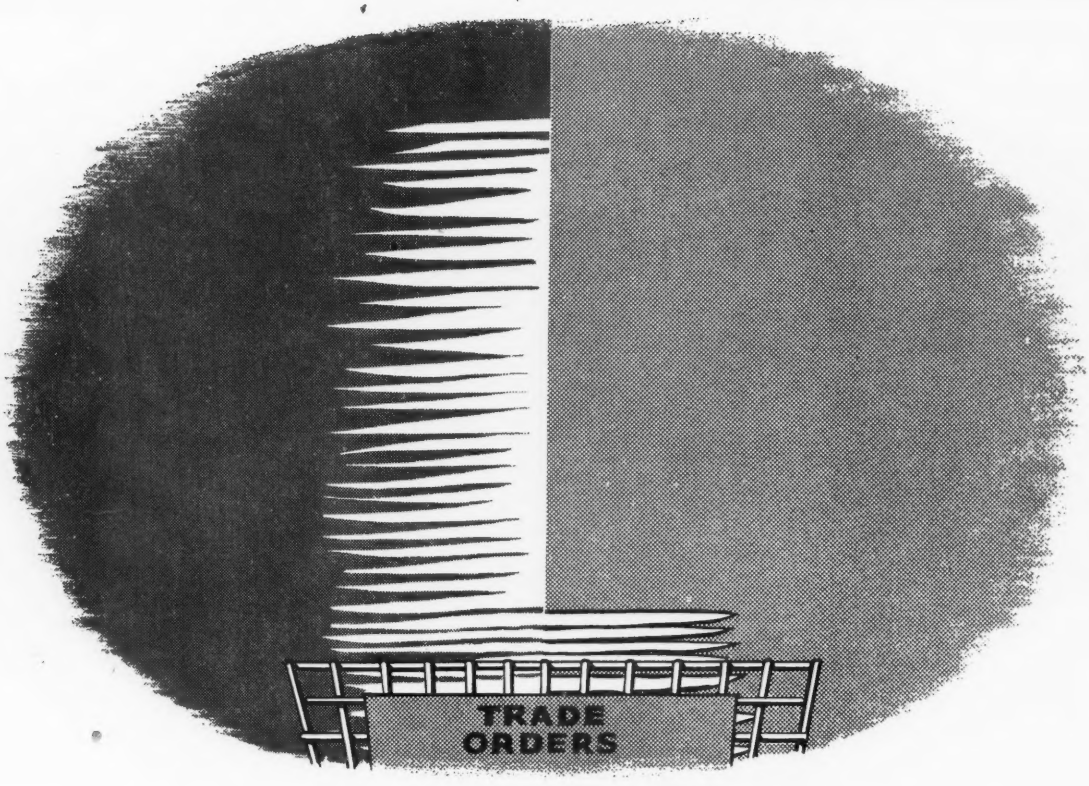

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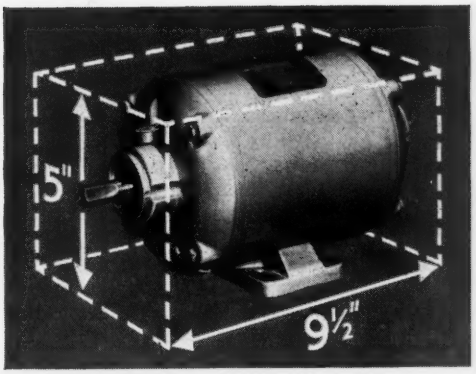

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A strong power unit for a wide variety of applications where space is limited. Built to the same standards as other motors of Brook manufacture.

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	3000	1500	1000	3000	1500	1000
BS42	1RD/3	1TH/4	1TH/8	1TH/6	1TH/8	1TH/16

SINGLE PHASE SUPPLY

FRAME SIZE	PROTECTED H.P. AT SYN. SPEEDS			TOTALLY ENCLOSED H.P. AT SYN. SPEEDS		
	3000	1500	1000	3000	1500	1000
BS42	1TH/6	1TH/8	1TH/16	1TH/10	1TH/12	1TH/25

- Ball or sleeve bearings at the same price
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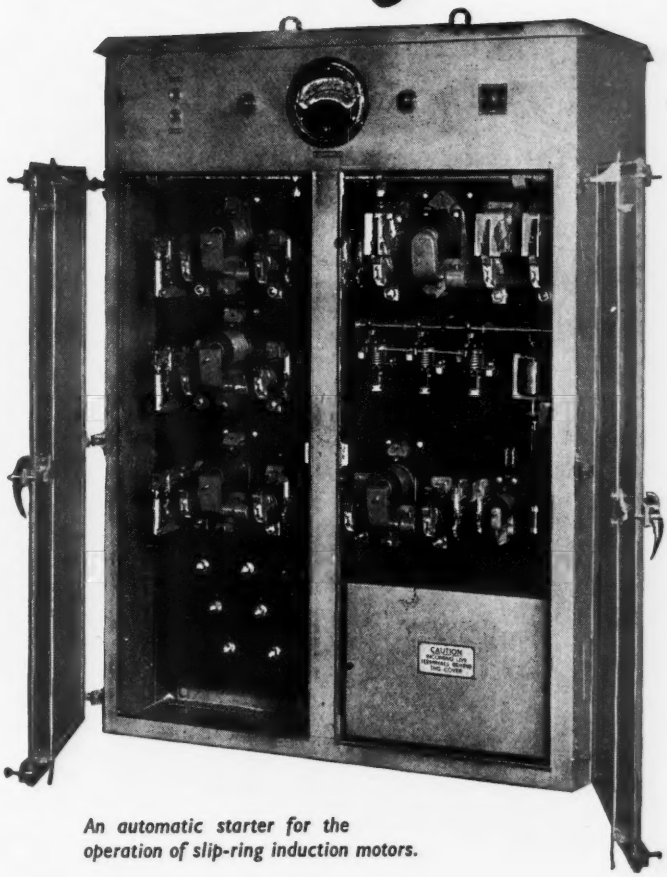

An automatic starter for the operation of slip-ring induction motors.

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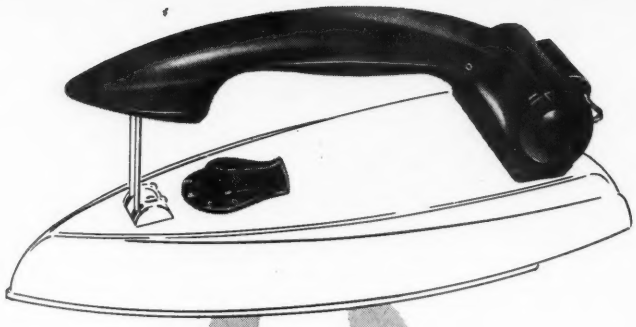

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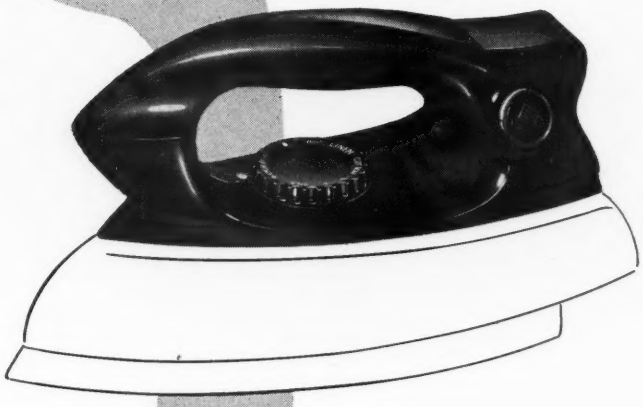
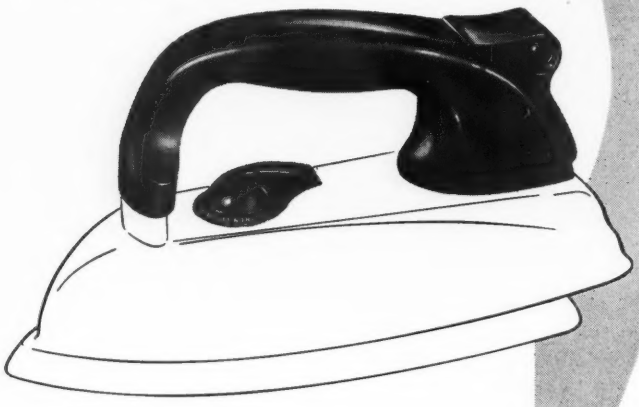
Large quantity production of these Morphy-Richards iron handles goes very smoothly . . . Perhaps we can mould some of your components?





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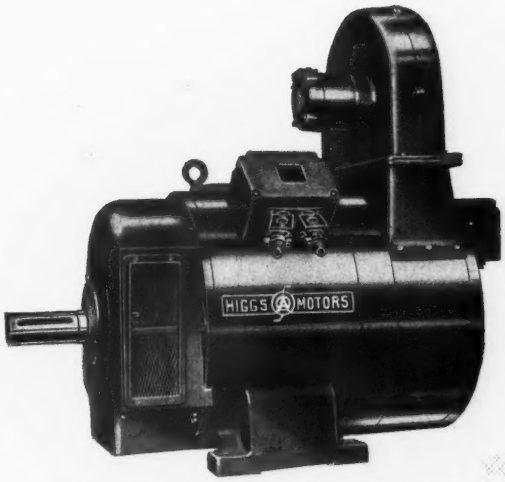

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PROTECTION PERFORMANCE Assured KLIXON THERMOSTATS

3¼" ROUND AUTO RESET

MOTOR PROTECTION

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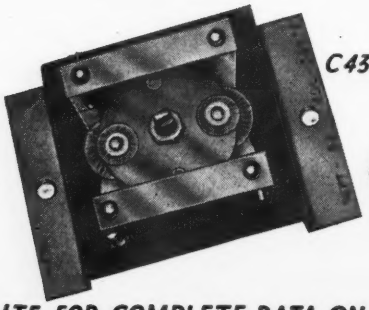
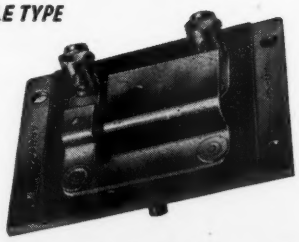


C4351 2POLE TYPE C4351 SINGLE POLE TYPE

OVERHEAT PROTECTION



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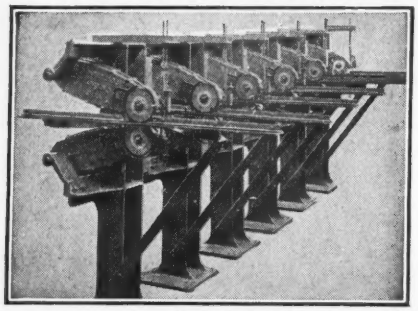
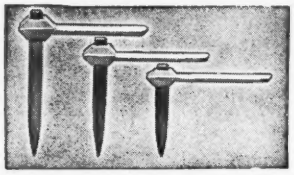


For removing the scale from 2 surfaces on one edge of plate simultaneously, preparatory to welding.

A batch of single-ended Pedestal Type

PATENT SCALING MACHINES

LEAD HEADED WALL NAILS



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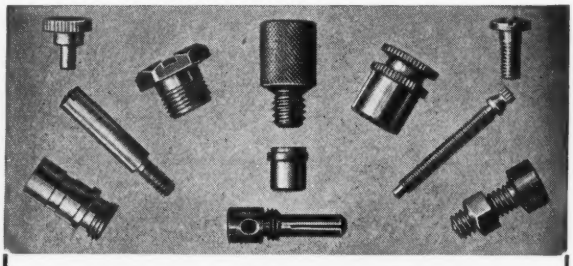

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Rounded edges of nut permit easy insertion Spring (your third hand) holds nut snugly in place for bolting.
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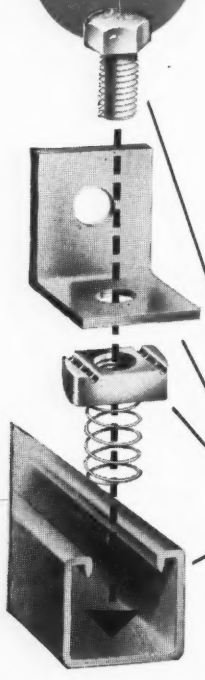

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½" and ¼" sizes.

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Unistrut Locking Nut.

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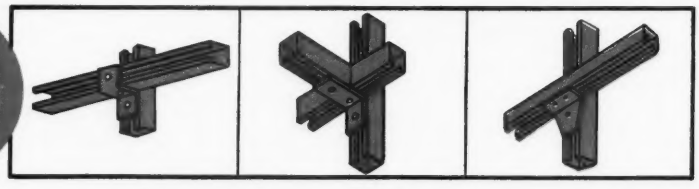
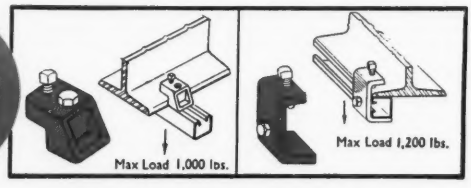
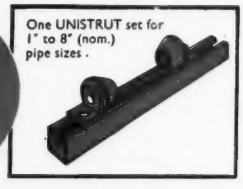


BEAM CLAMPS



ROLLER PIPE SUPPORTS



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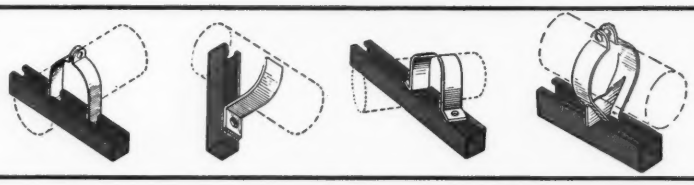
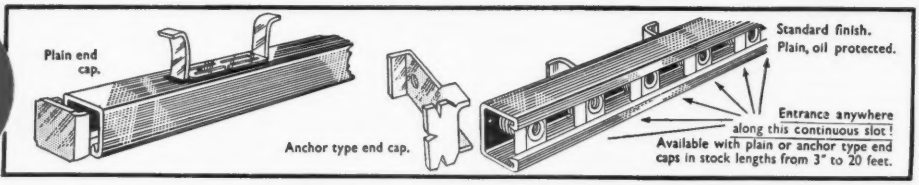


CONCRETE INSERTS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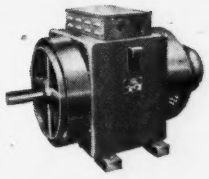

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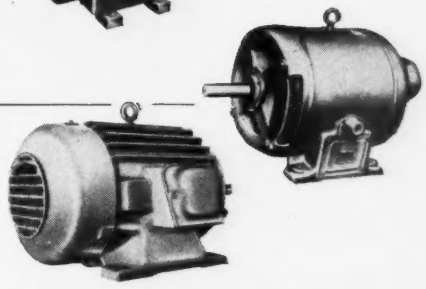

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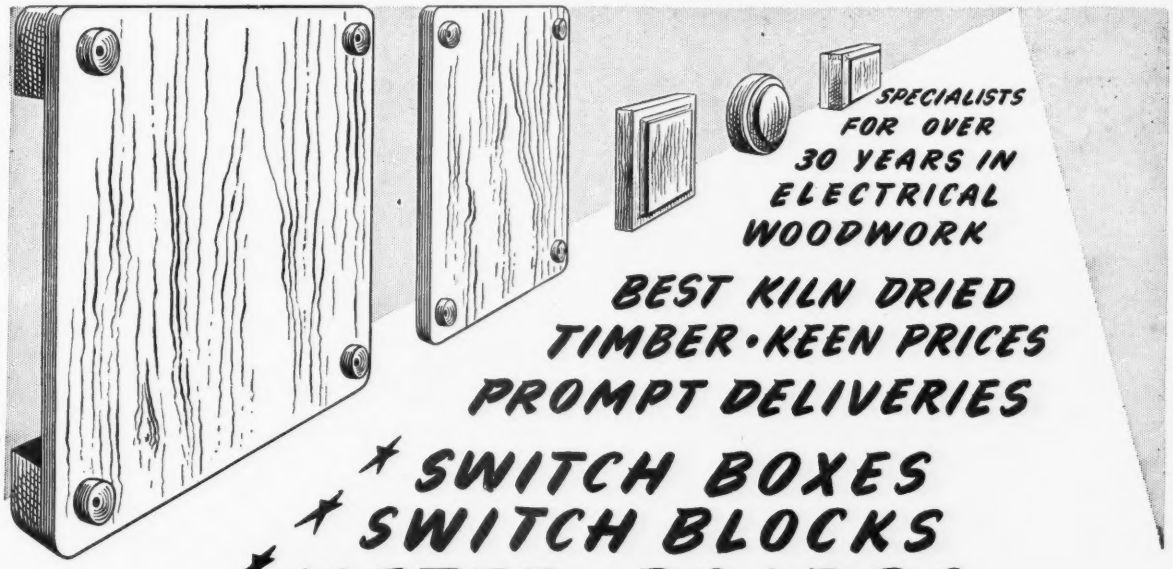

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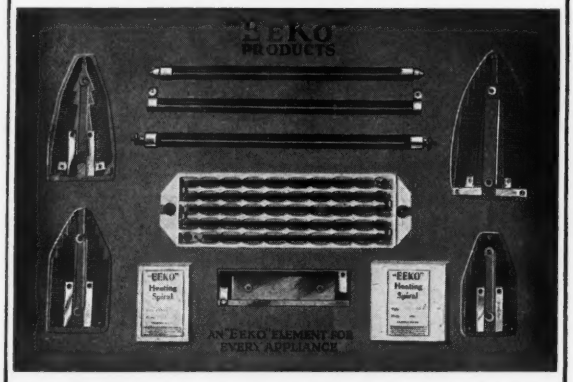

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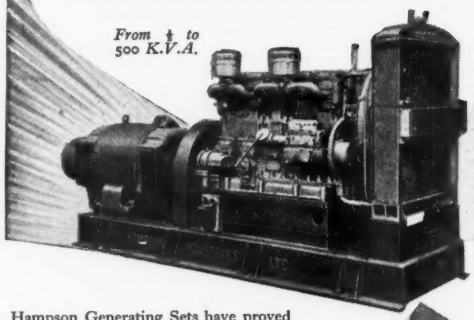
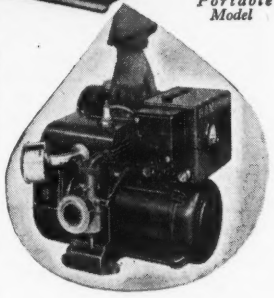


Illustrated below is the Portable Model



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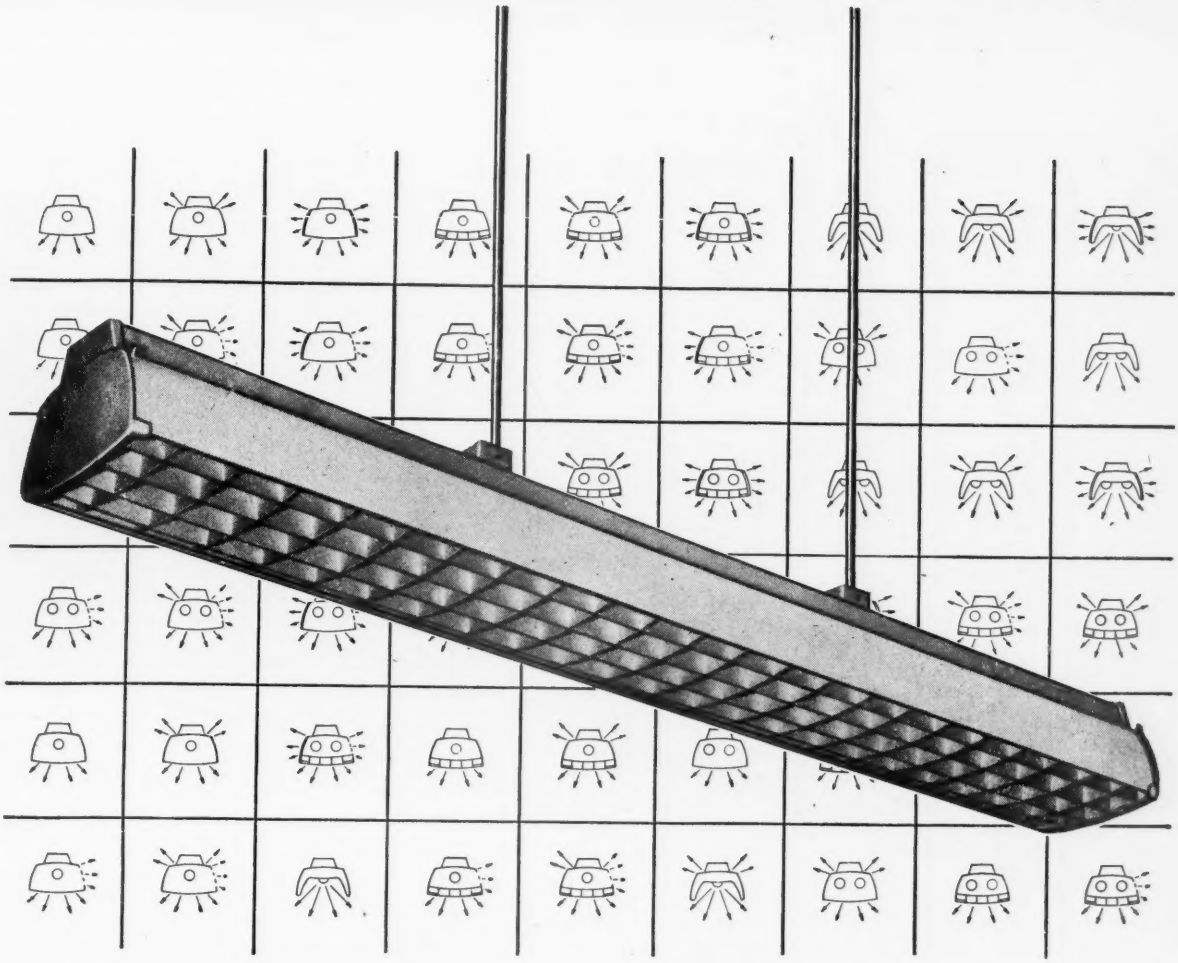

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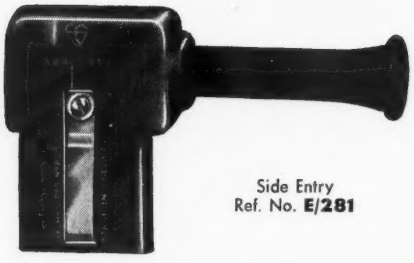

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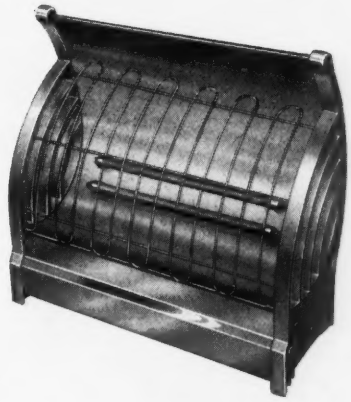

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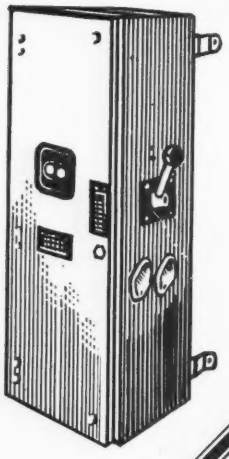

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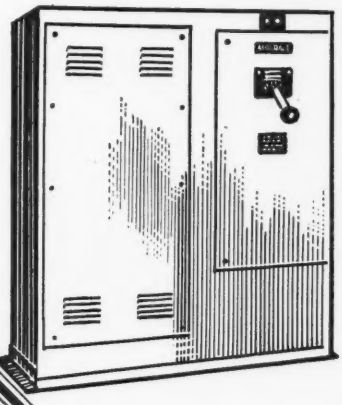

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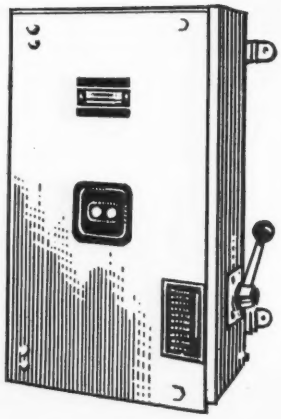

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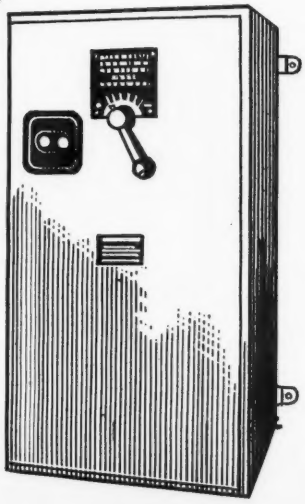

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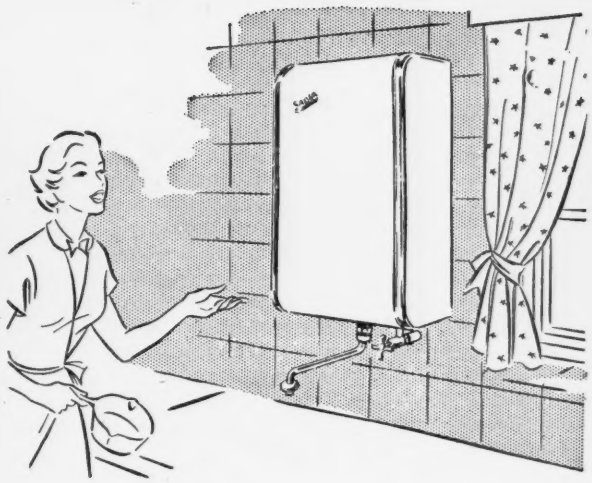

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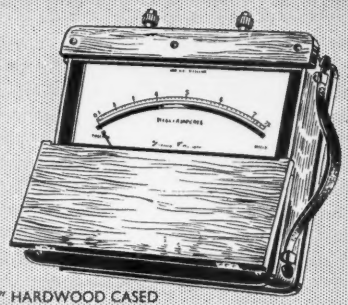

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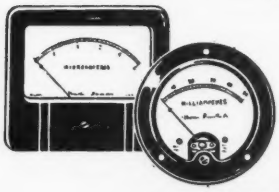

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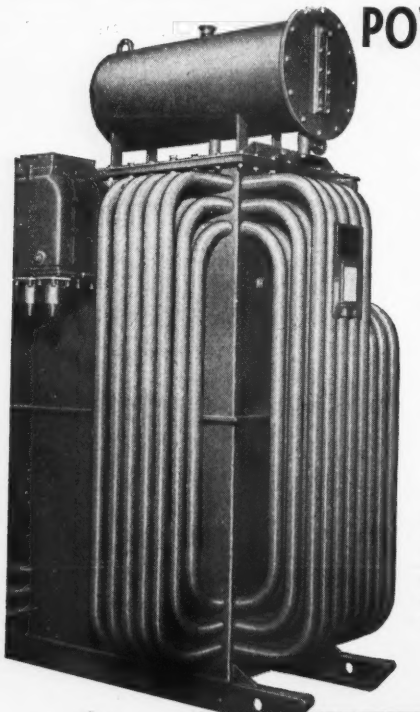

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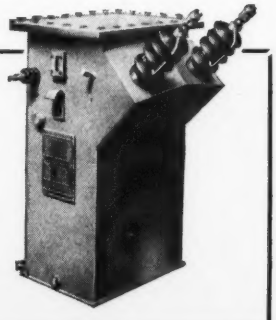

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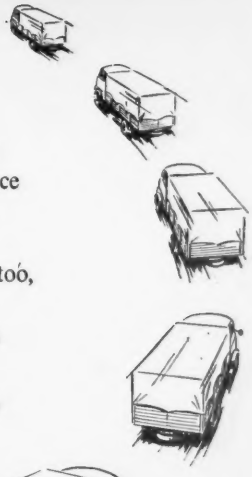

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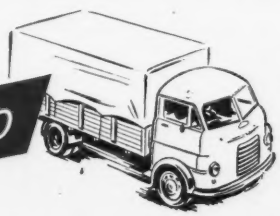

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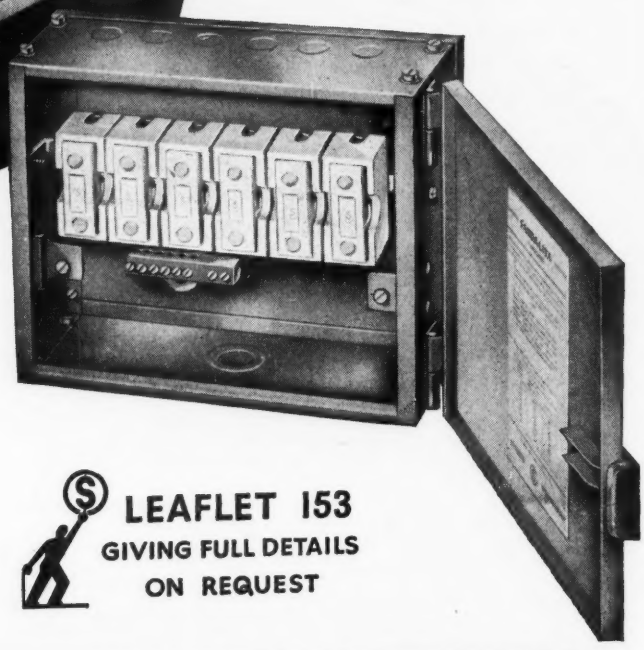

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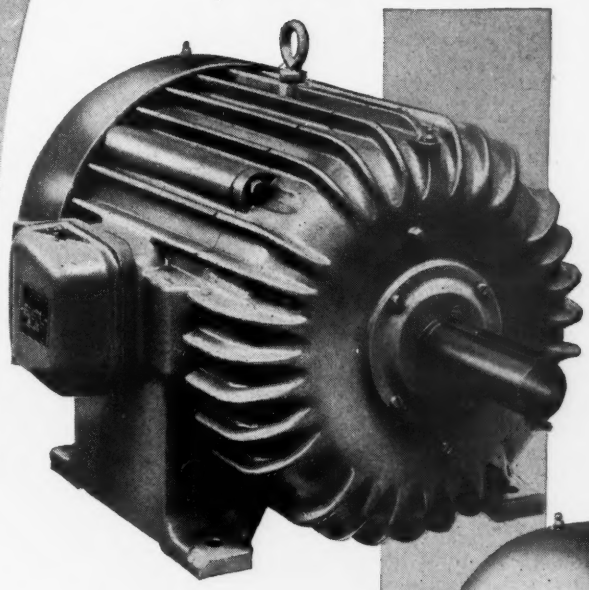

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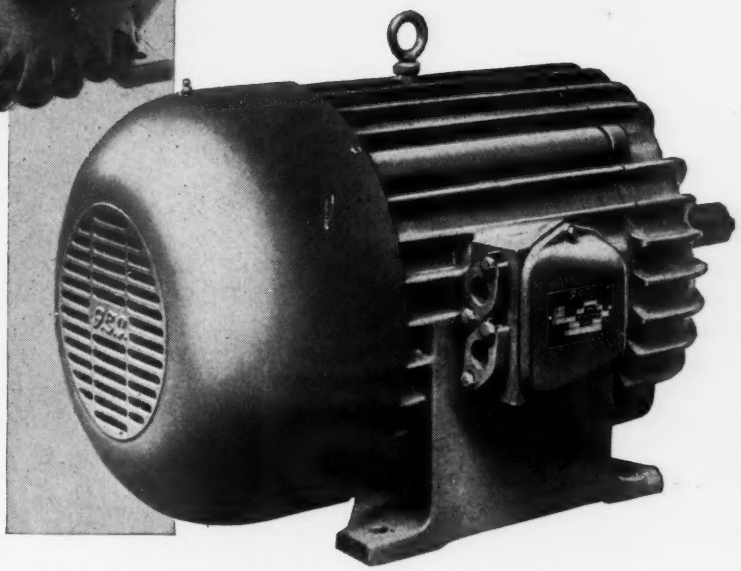

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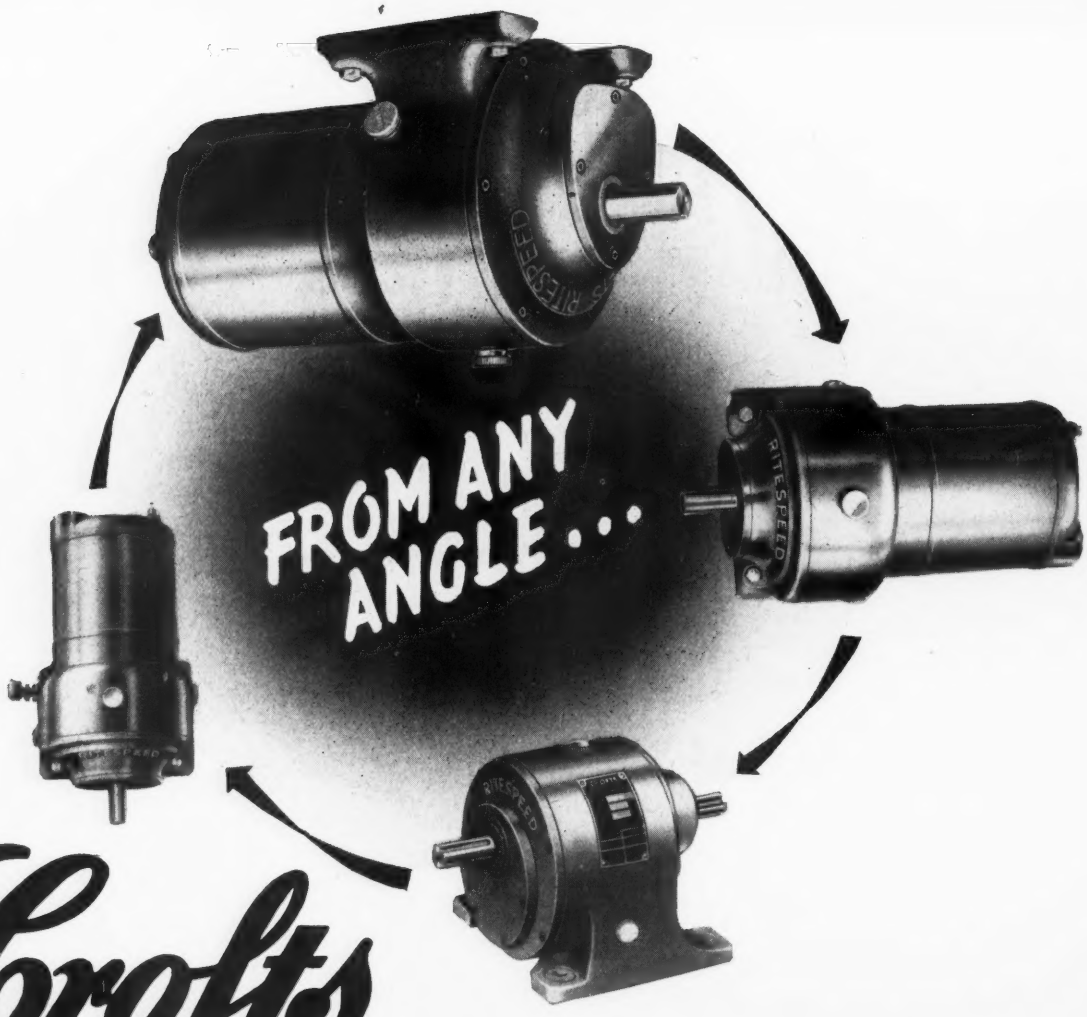

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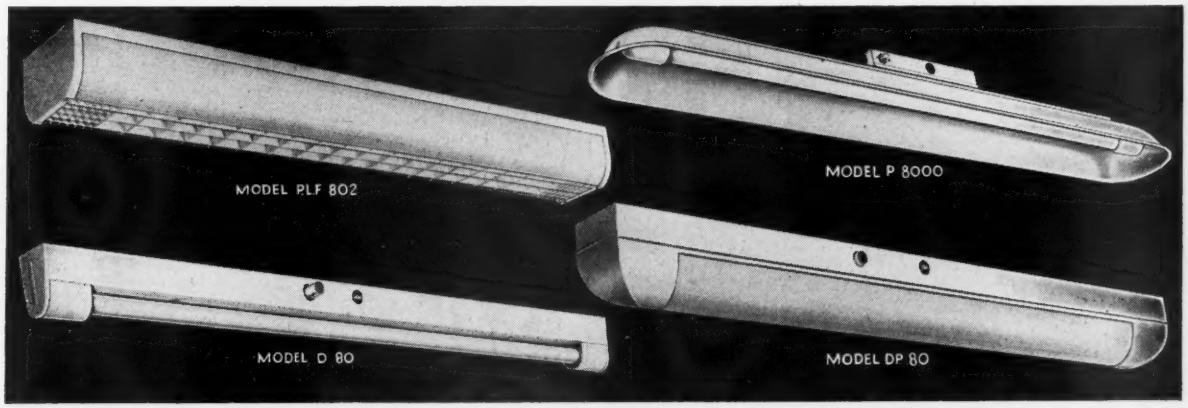

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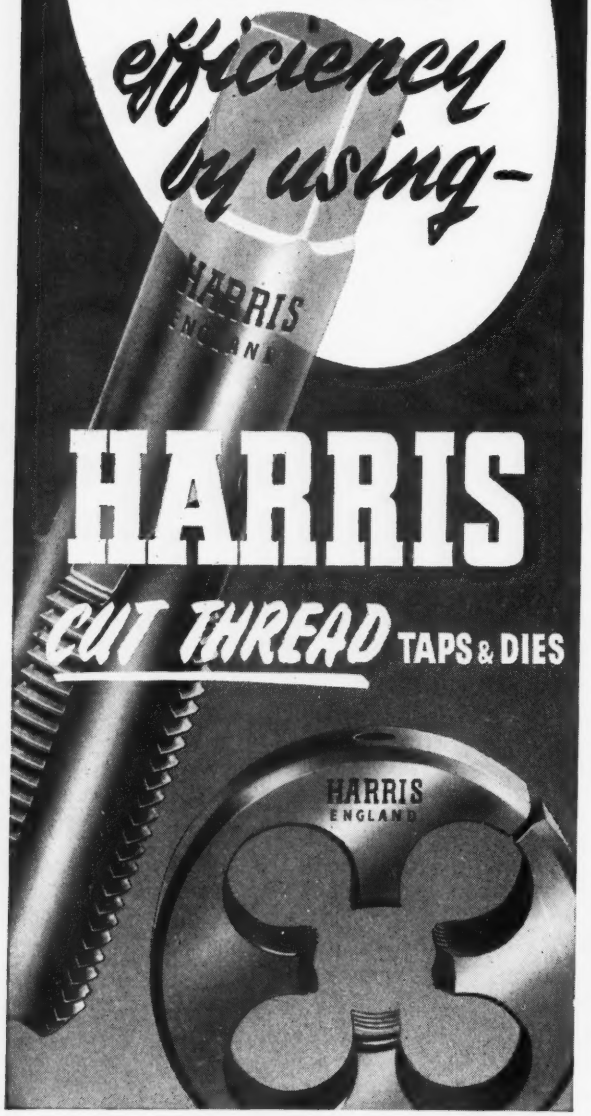

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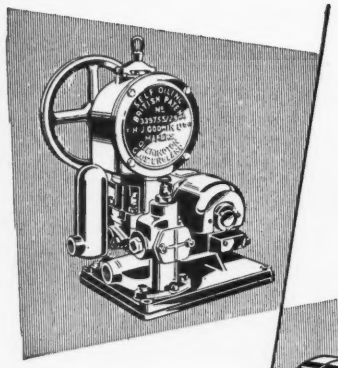

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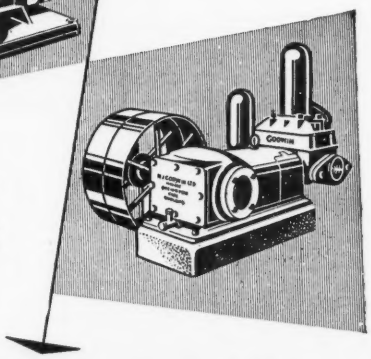

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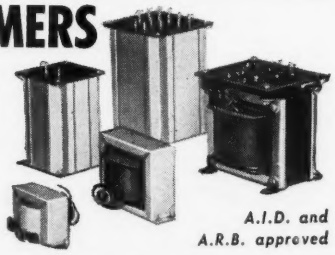

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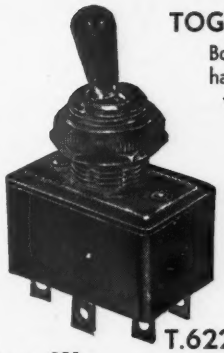

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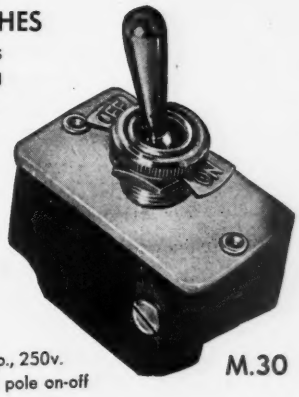

M.30

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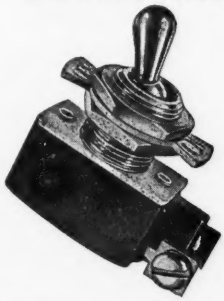

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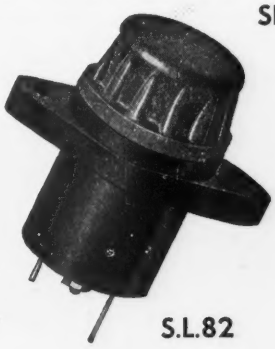

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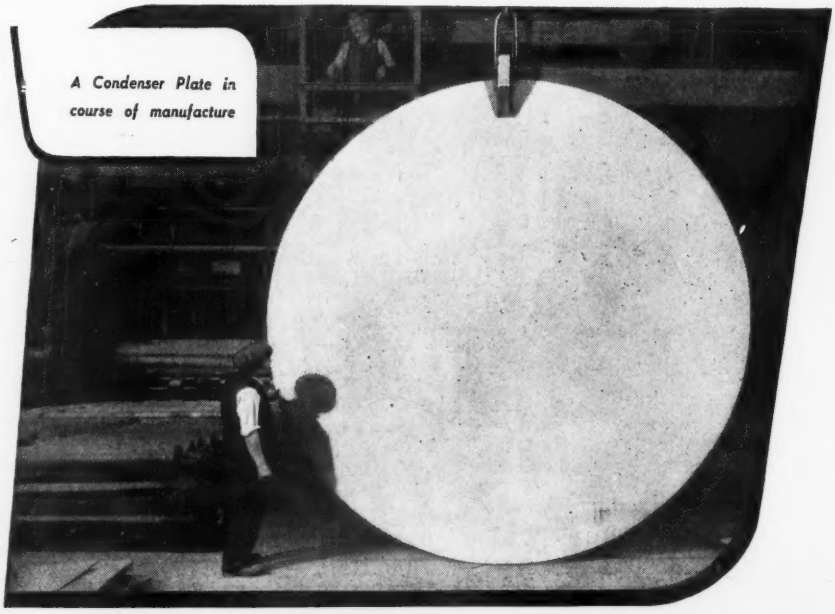

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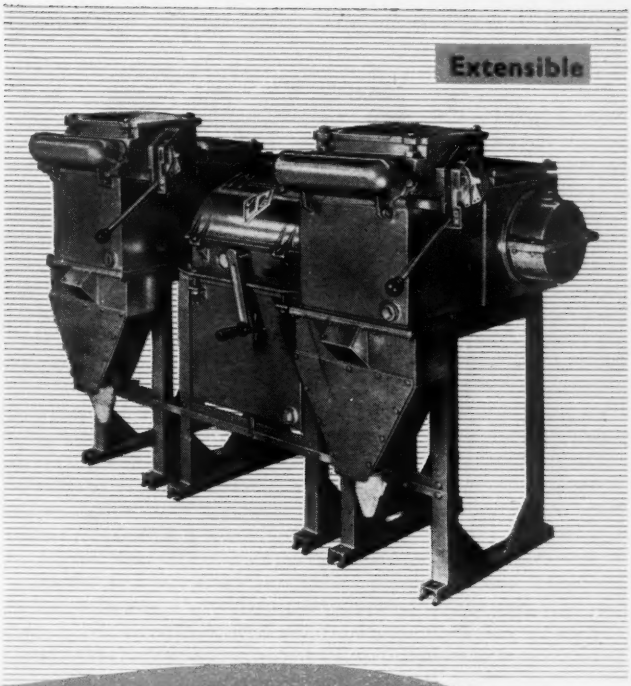

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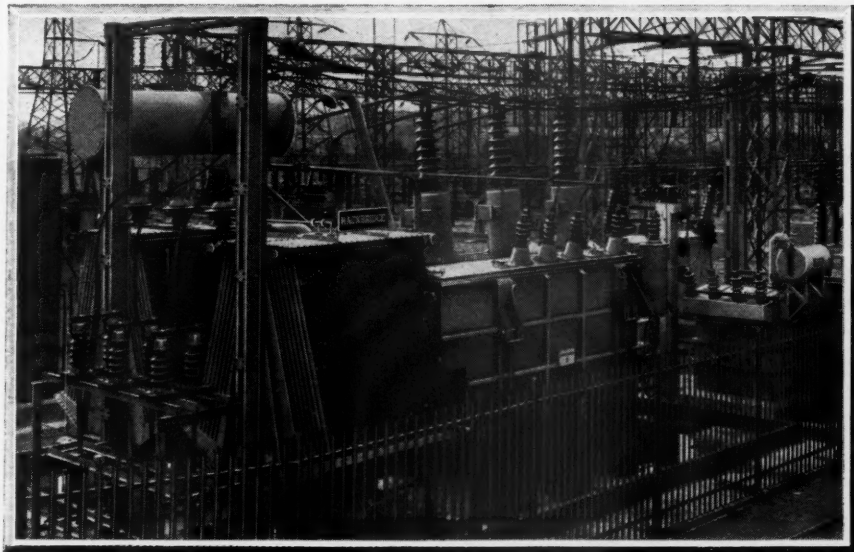

A 45,000 kVA 132/33 kV type ON/OFB transformer at Northfleet. This is one of twelve similar Hackbridge units supplied to the British Electricity Authority.

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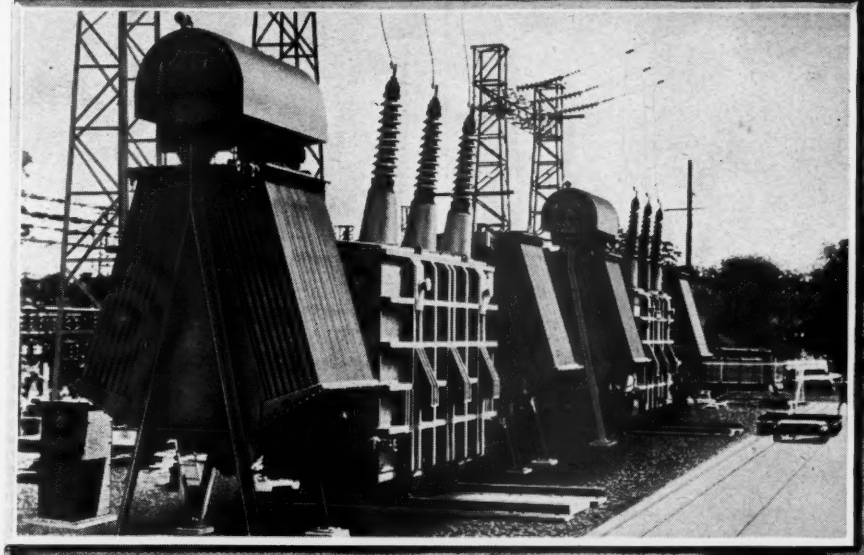

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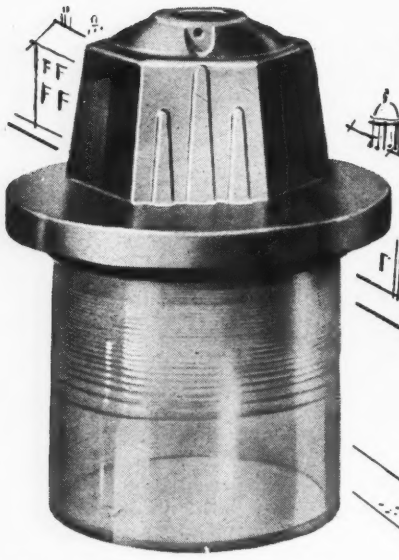

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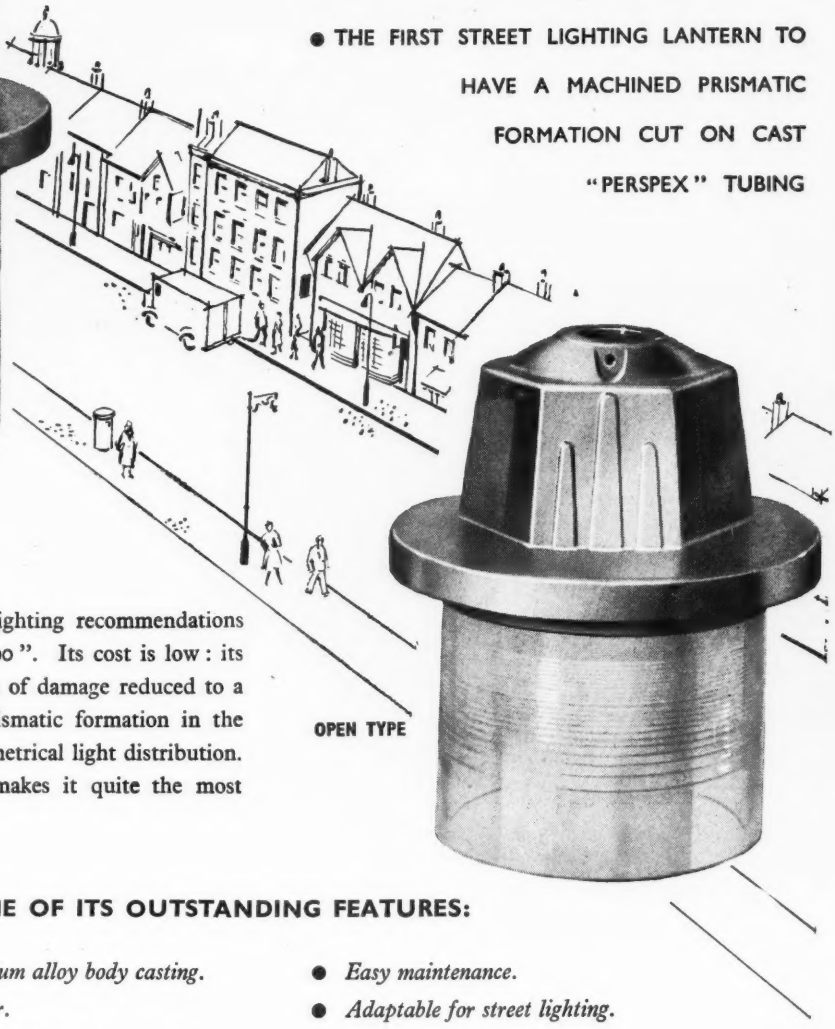

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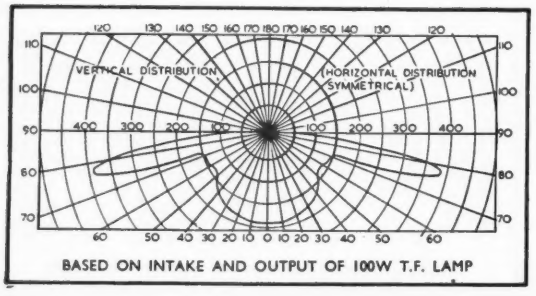

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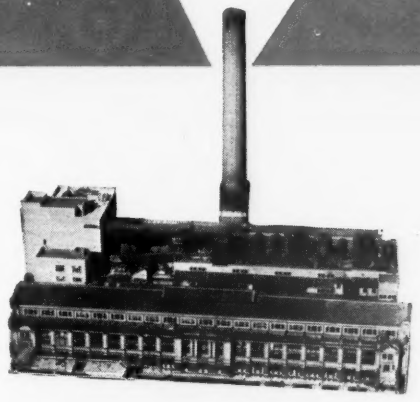

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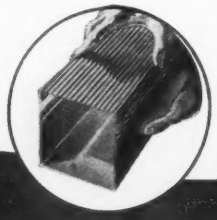

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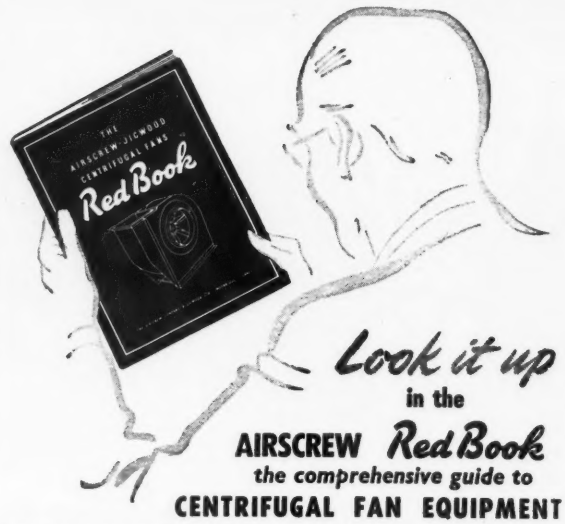

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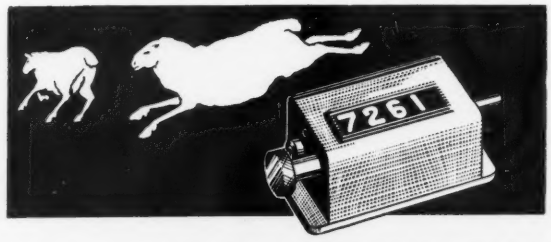

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Developed by us for the Ministry of Supply, the T.1 relay provides a sealed and improved version of the K type relay.

The instrument is robust and compact, and is particularly suitable for use in aircraft or as a starter relay for internal combustion engines. Die-cast alloy case finished in stove-black glossy enamel, with the terminals protected by removable bakelite cover.

Manufactured in accordance with full Ministry Specifications. A.I.D. or A.R.B. released as desired.

SPECIFICATION

- **COIL** 24v. D.C. normal. Continuously rated, vacuum impregnated and baked after winding.
- **CONTACTS** Silver. S.P.
- **RATING** 100 amps. continuous.
- **DIMENSIONS** 3" wide × 4" high. Fixing: two 0 B.A. clear fixing holes on 2¼" centres.

Hendrey Relays

Write for full details of the Hendrey Range

HENDREY RELAYS LTD. · BATH ROAD · SLOUGH · BUCKS · Telephone: Burnham 609/610
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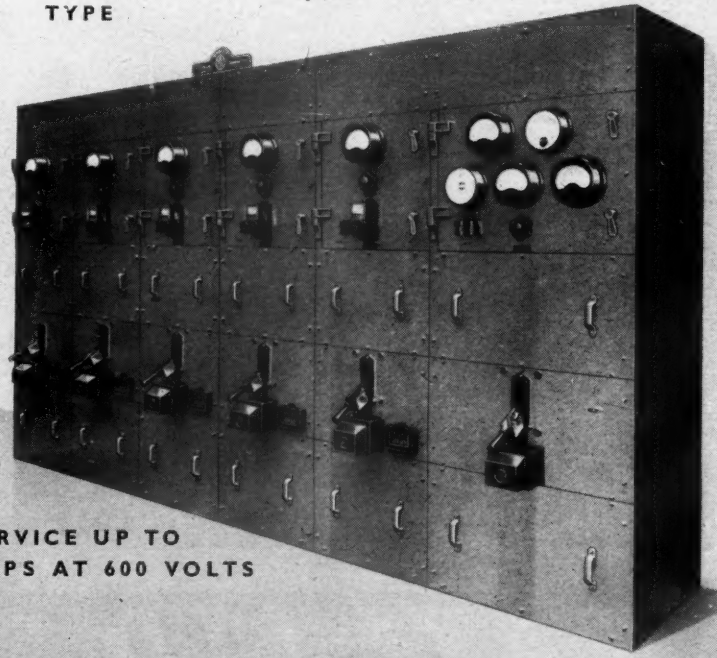

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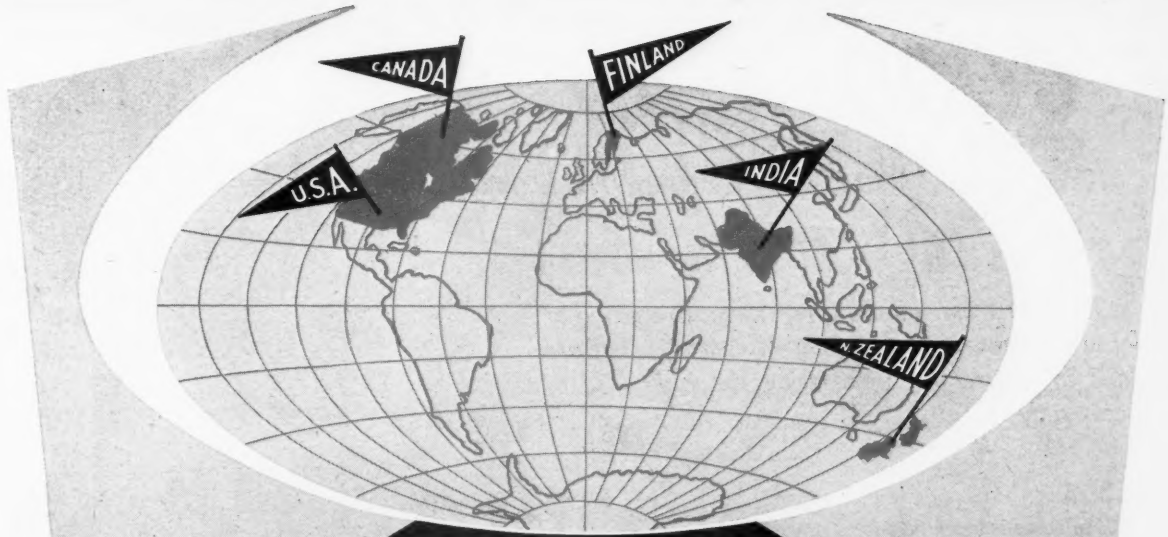
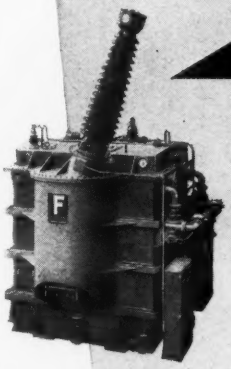


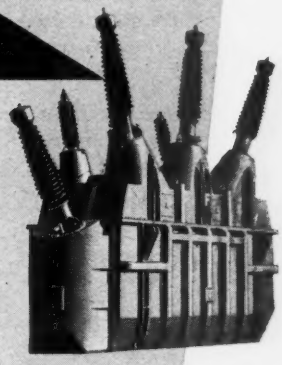
FERRANTI
TRANSFORMERS

FAMOUS THROUGHOUT THE WORLD



U.S.A. Nine 33,333 kVA, 230,000 volt single-phase Ferranti transformers are being supplied to the U.S. Army Corps of Engineers for the Garrison Dam Project, North Dakota, U.S.A. Three, forming the first 100,000 kVA bank, have been shipped.

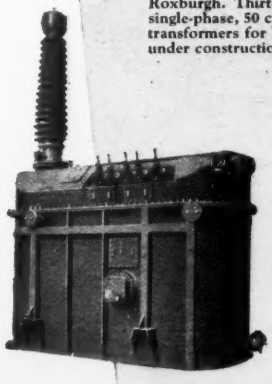
FINLAND Six 230,000 volt, three-phase Ferranti transformers have been ordered by the Imatra Power Company, Finland, for the Hikia Transforming Station and the Pyhäkoski Generating Station. Five are now in commission.

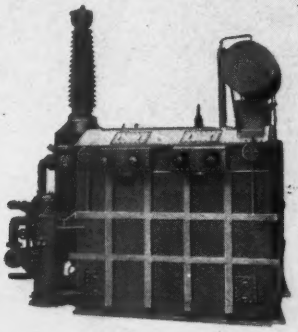


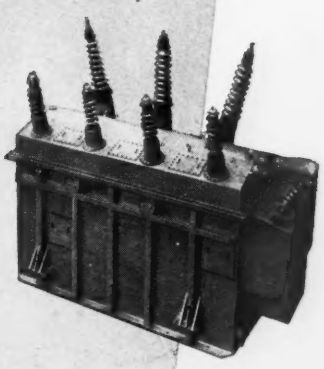
NEW ZEALAND Twenty-six Ferranti large power transformers have been ordered by the State Hydro-Electric Department of New Zealand. Thirteen 14,800 kVA, single-phase, 50 cycles, 11/220 kV transformers have already been supplied to Roxburgh. Thirteen 9,259 kVA, single-phase, 50 cycles, 11/220 kV transformers for Whakamaru are under construction.

CANADA Four 71,000 kVA, 301,400 volt single-phase Ferranti generator transformers and three 37,000 kVA, 275,000 volt step-down Ferranti transformers have been supplied to the Aluminum Company of Canada Limited for the Alcan Project at Kemano and Kitimat, British Columbia.

INDIA Three Ferranti 20,000 kVA, OFB, 3-phase, 50 cycles, 132/33.66 kV Transformers with on-load tap changing gear and two Ferranti 10,000 kVA, ON/OB, 3-phase, 50 cycles, 132/33 kV transformers with on-load tap changing gear have been supplied for the Damodar Valley Power Scheme in India.







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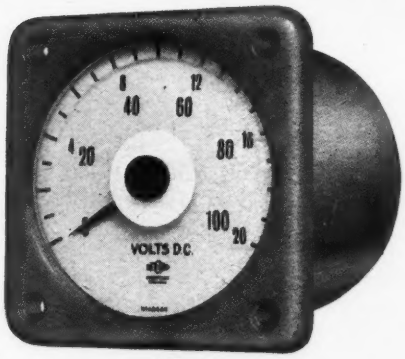
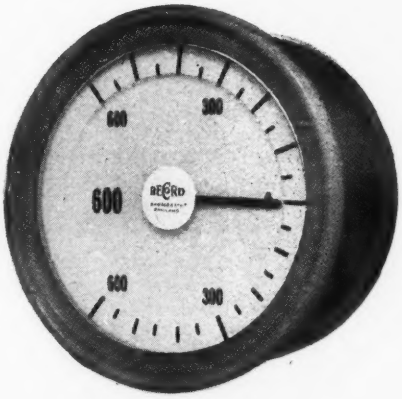


Series A

These instruments are a representative group of special instruments available from "Record." They are available in various forms covering the wide field of power instrumentation.

SERIES A

3½" square flush "Cirscale" instrument with clear vision scale recently designed to meet British Admiralty shock test requirements but now available for industrial use where a small exceedingly robust instrument is required.



Series P

SERIES P

Where conditions require an instrument larger than Series A, but with the same clear vision scale, this can be provided by the Series P, "Cirscale" in 4", 6" and 8" diameter sizes. Special glasses to minimise reflection can also be supplied.

SERIES H

To meet stringent climatic conditions of service, for example, mobile generating plant operating under tropical conditions, a range of hermetically sealed instruments is available. Enclosed in substantial cast aluminium cases with wide flanges and adequate gaskets for sealing, they are extremely robust and suitable for wide variation of climatic conditions.

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A wide range of standard instruments is also available for quick delivery.

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ELECTRICAL INSTRUMENTS

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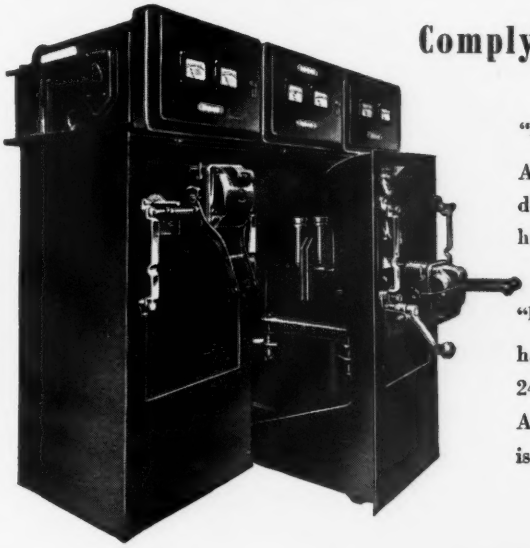

"ELLISON" 11kV. 250 M.V.A. SWITCHGEAR

Arrangements include vertical isolation, arc control devices, flush mounted instruments and closing by hand, spring or solenoid.

"ELLISON" 660 VOLT DISTRIBUTION SWITCHBOARDS

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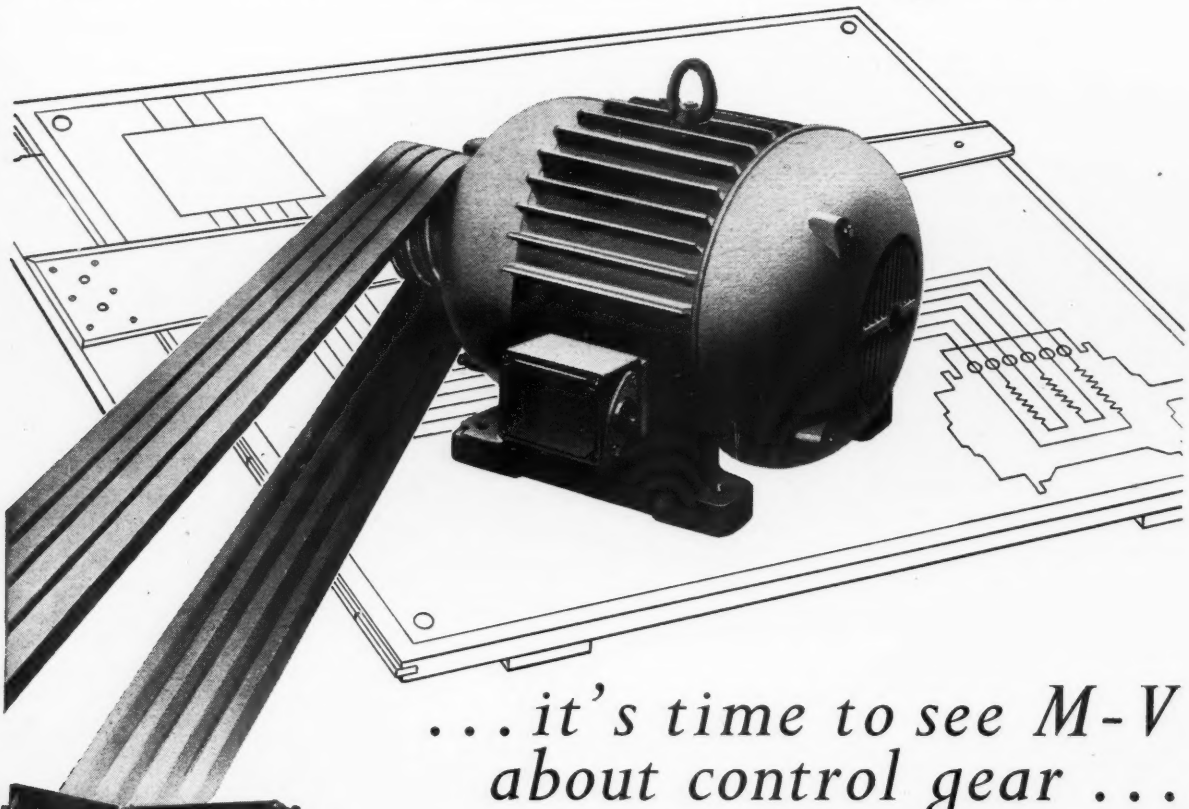
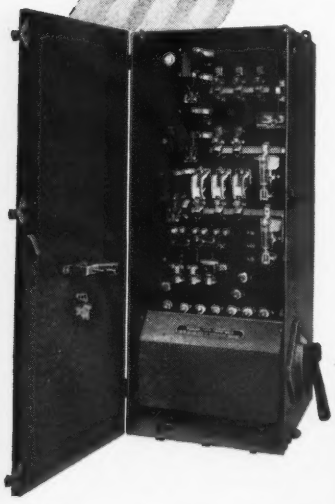
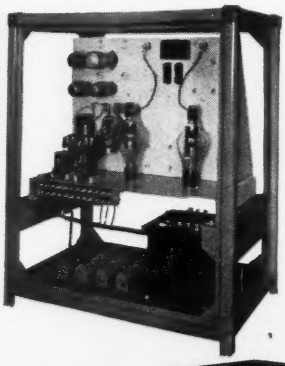


... it's time to see M-V about control gear ...

When you are thinking of installing a motor, think also of Metrovick control gear. Trouble, time and cost are saved by consulting M-V when a motor drive is in the planning stage. M-V design and build all types of control gear from switch-starters for fractional hp motors to elaborate electronic controls for complex industrial processes. The experience of M-V engineers therefore covers the complete range of control gear and their practical advice is at your service.



M-V Stator-rotor Contactor Starter



M-V Electronic Speed-control Equipment

M-V Hand-operated Oil-break Starter

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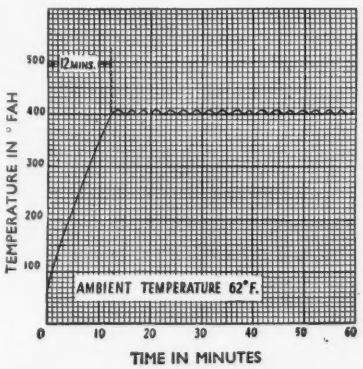

The graph alongside shows that a temperature of 400°F is reached from an ambient temperature of 62° in **only 12 minutes.**

Yes, this new "Luxury" C.90 will be a quick seller—particularly when the purchaser knows that an exclusive Pyrex heat-resisting glass casserole/grill pan, a heated drawer, and an 8' radiant plate with simmer control are all included for the moderate price of £48.

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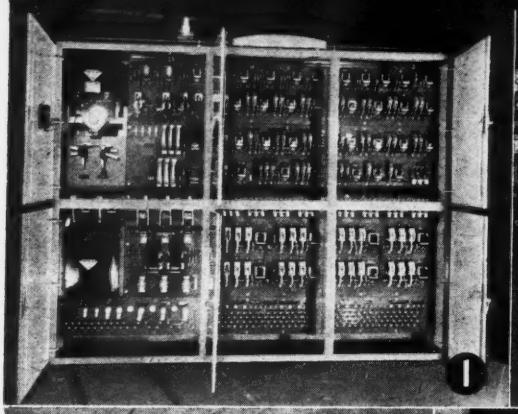
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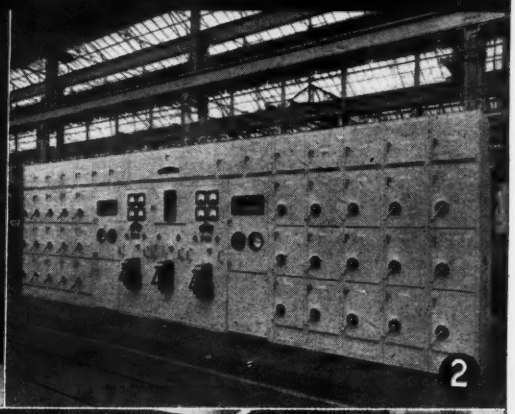
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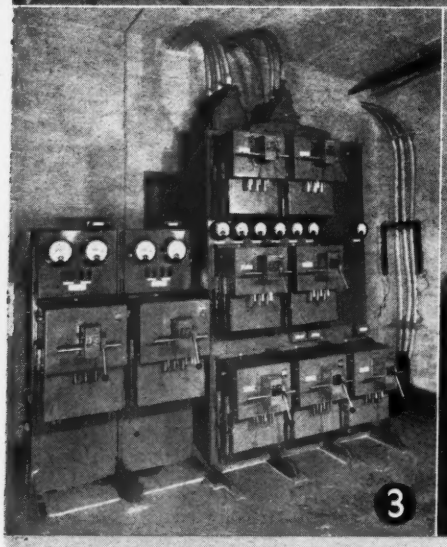
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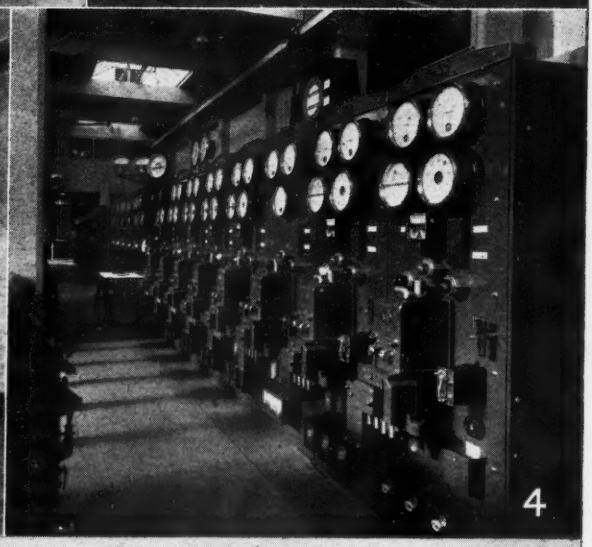
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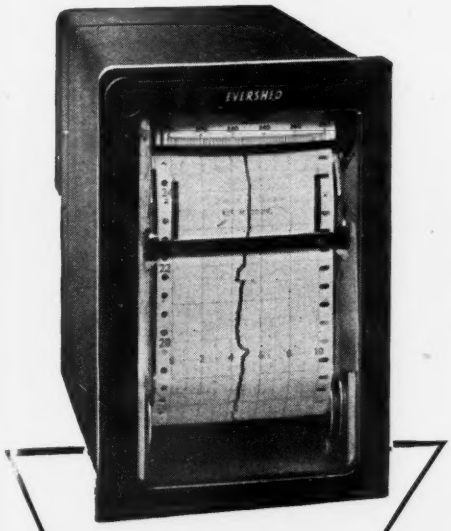

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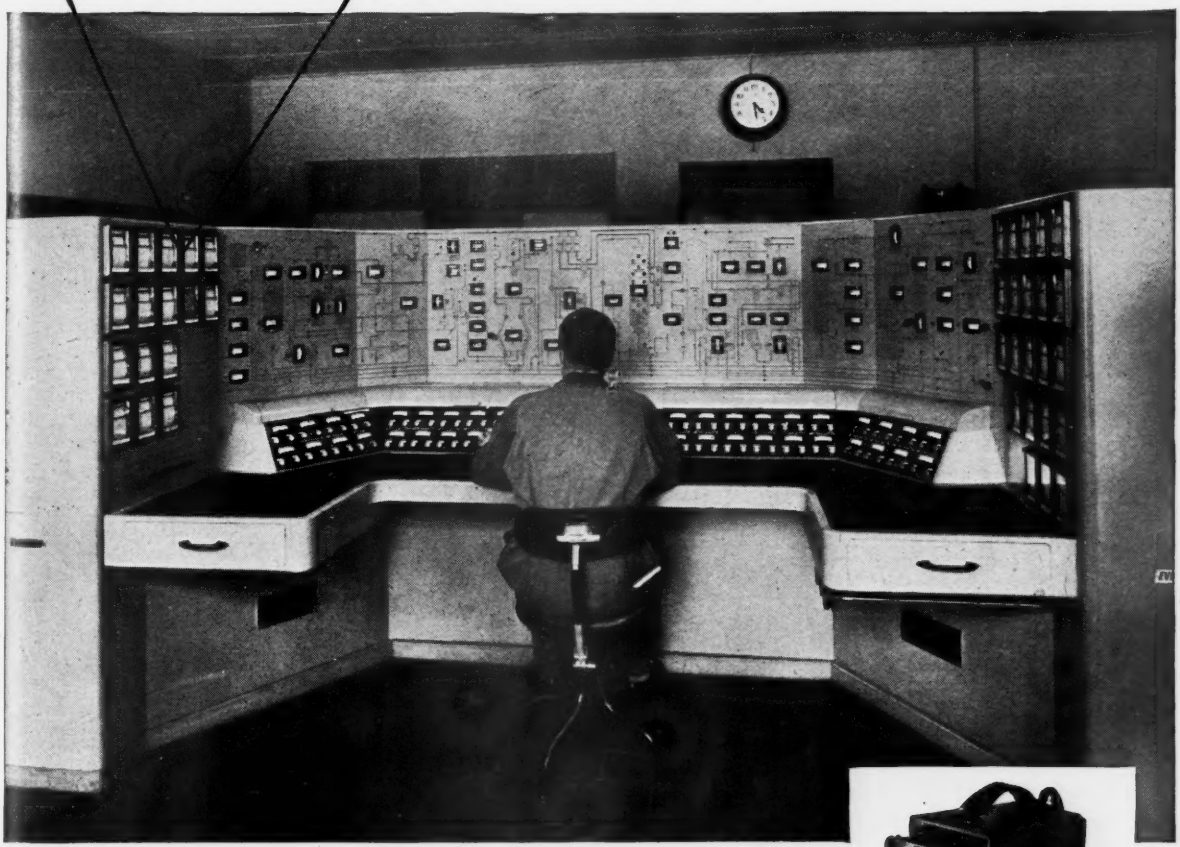

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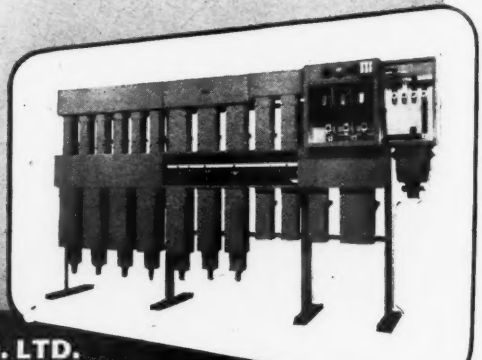

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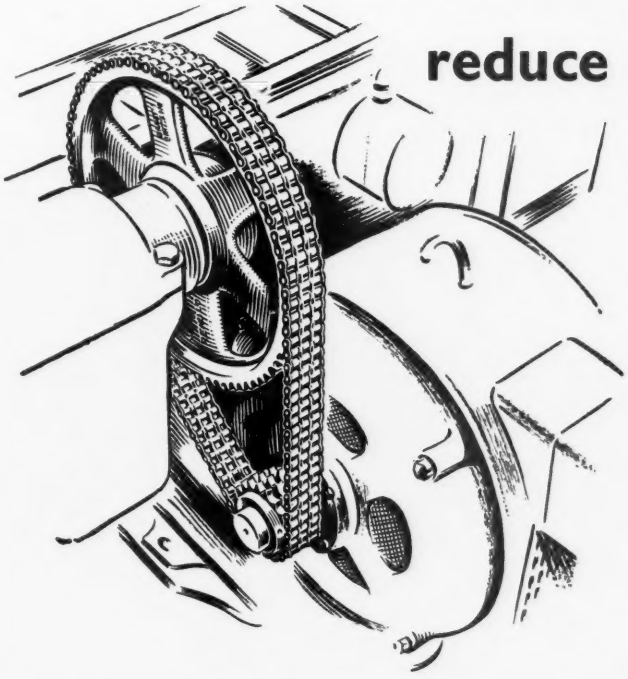

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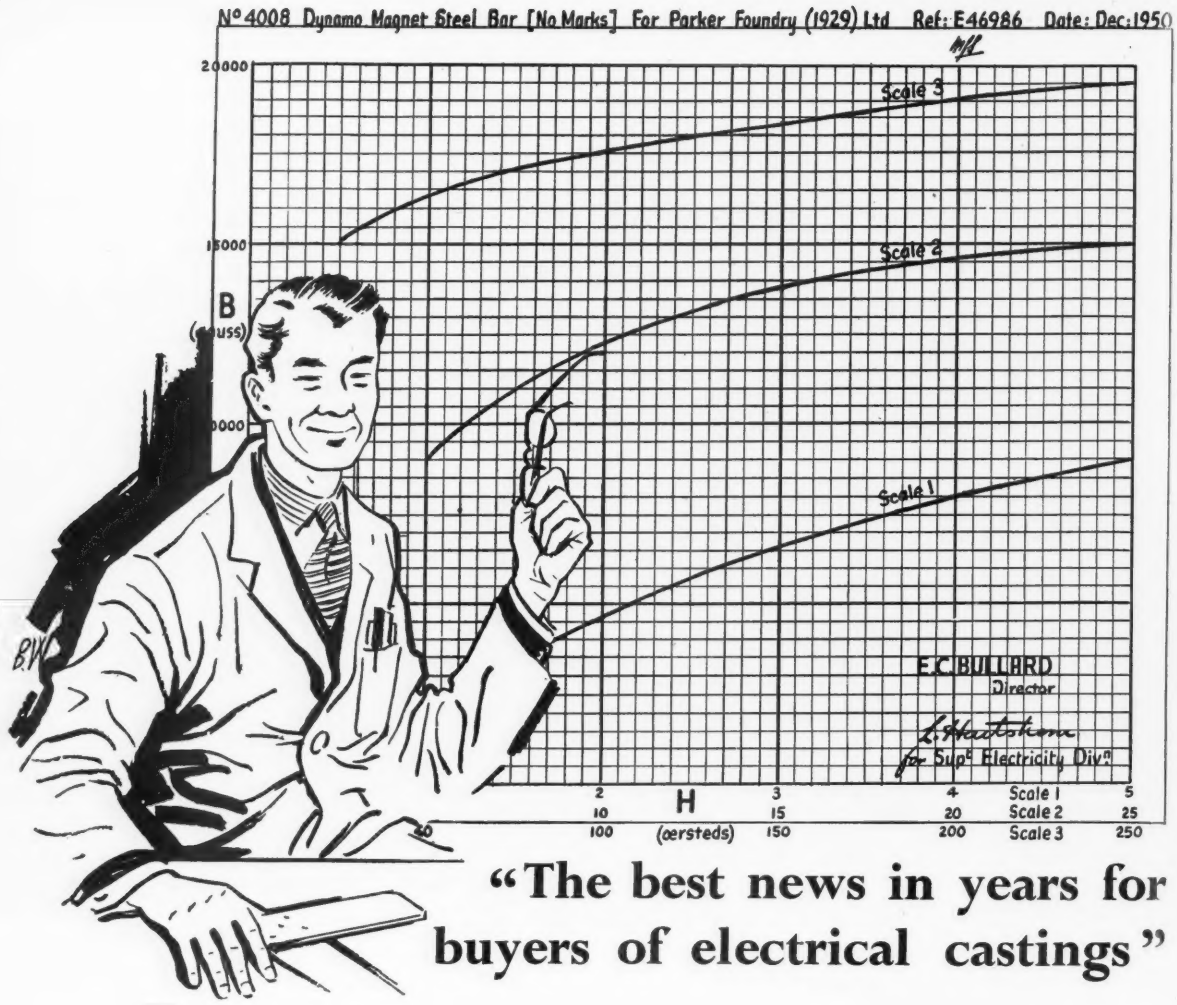

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NATIONAL PHYSICAL LABORATORY

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(NO MARKS)

TESTED FOR:- MESSRS. PARKER FOUNDRY (1929) LTD.,
"TROPENAS" STEEL WORKS,
DERBY.

The material was brought into successive steady cyclic states of H and B from the corresponding values the following Table and accompanying curve were obtained.

TABLE

H oersteds	B gauss	μ
0.2	100	500
0.3	180	600
0.5	400	800
0.7	750	1 100
1.0	1 600	1 600
1.5	3 250	2 170
2.0	4 600	2 300
3.0	6 560	2 190
5.0	9 000	1 800
7.0	10 640	1 520
10	12 250	1 225
15	13 780	919
20	14 580	729
30	15 420	514
50	16 320	326
70	16 900	241
100	17 540	175.5
150	18 360	122.5
200	19 000	95.0
250	19 550	78.2

E. C. BULLARD
Director.

Date 12th December, 1950.
Reference E.469.86.
Passed by C.S.H.
for Superintendent, Electricity Division.

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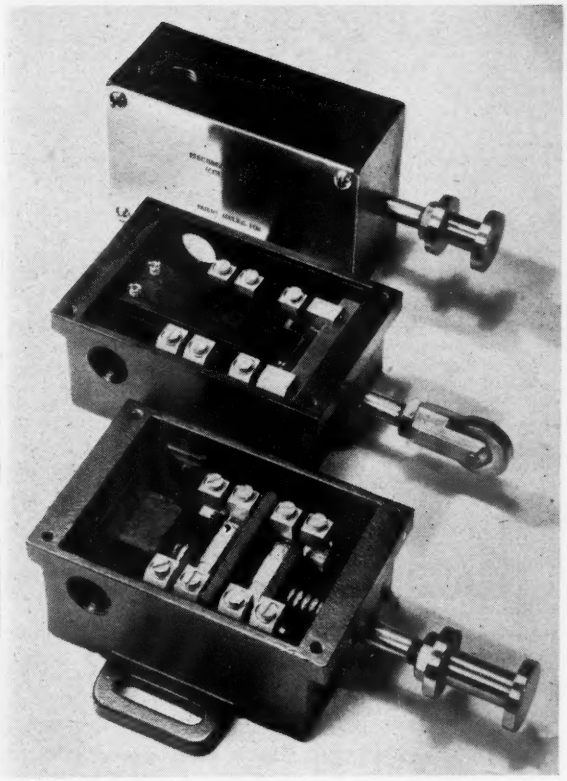
"COLNE"
SWITCHGEAR



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"*SPECIALS*" designed and supplied where required

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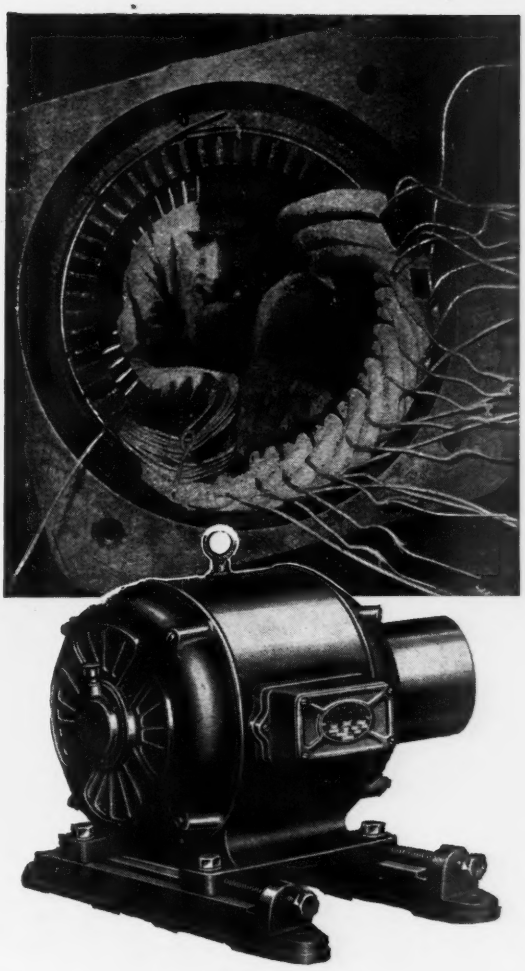

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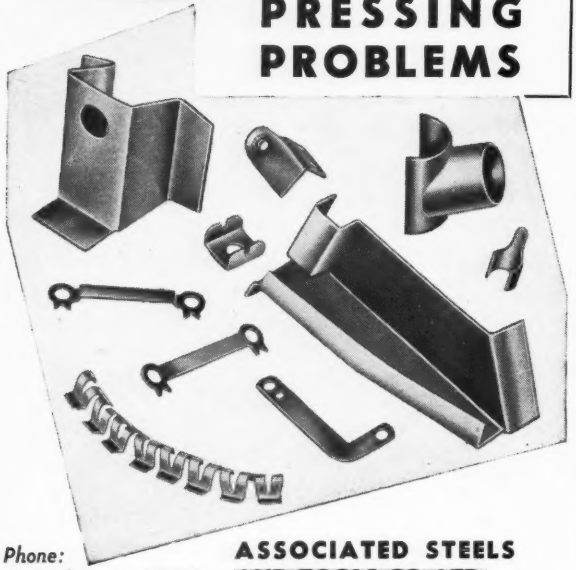

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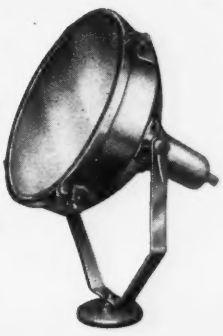

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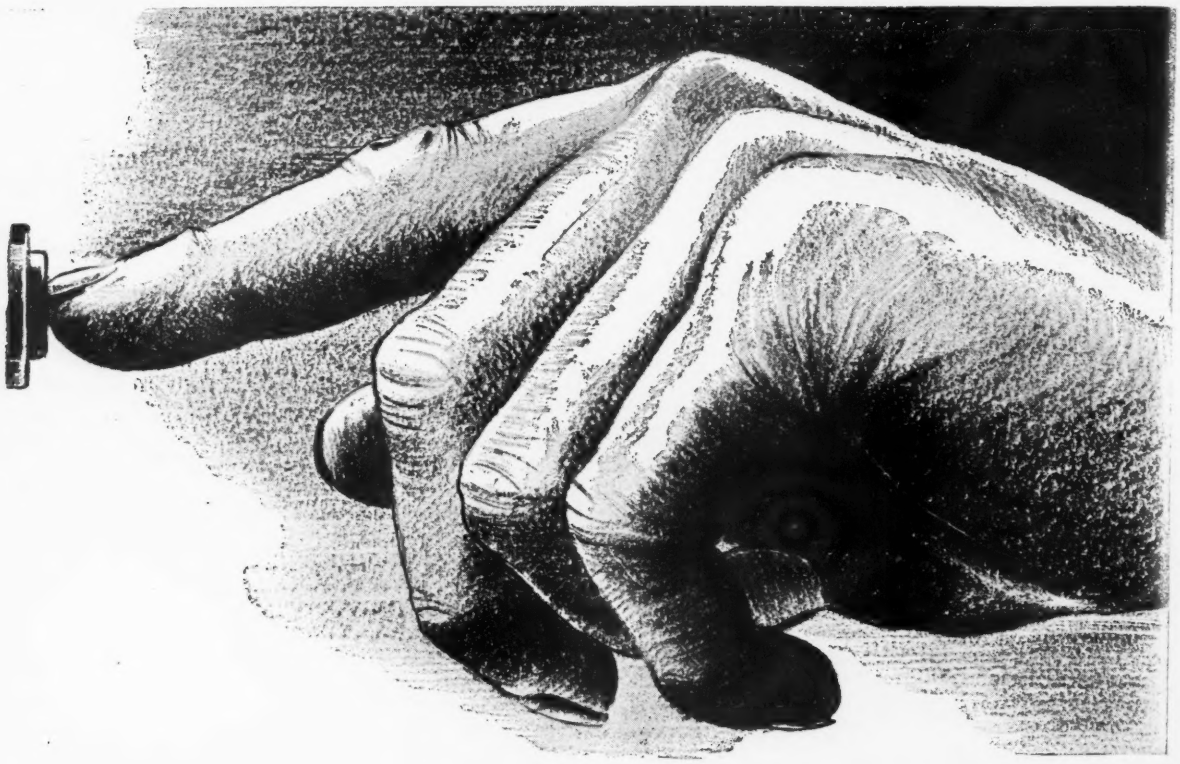

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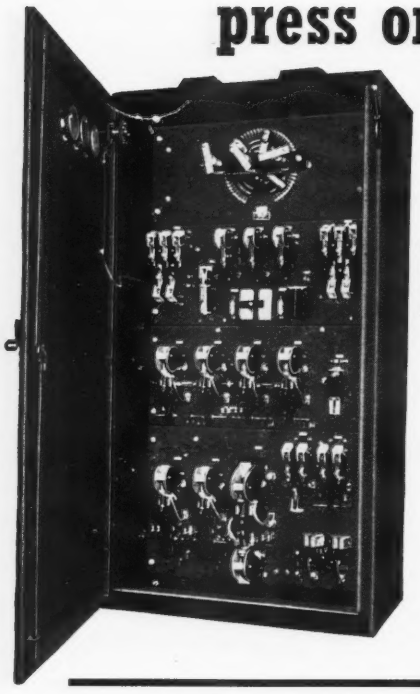

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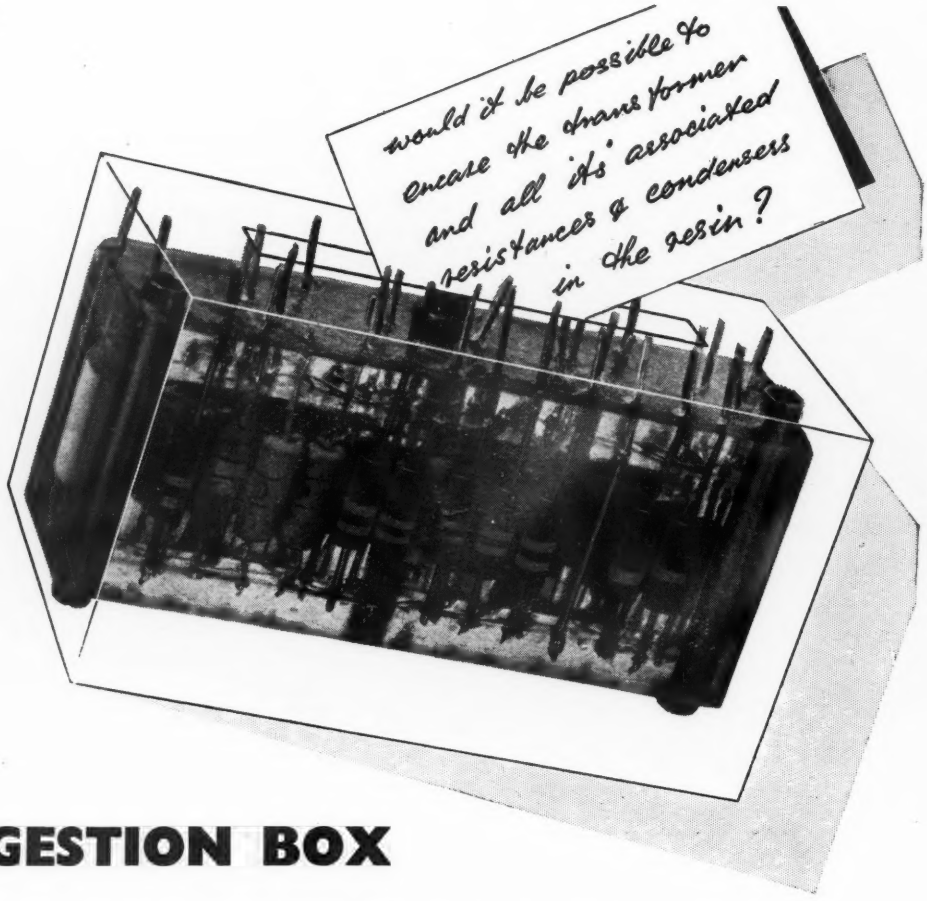

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P.67

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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31 DECEMBER 1954

In This Issue

1027 GENERATION AND DISTRIBUTION
1029 TESTING LARGE SYNCHRONOUS CONDENSERS
1034 ENGINEERING IN EUROPE
1035 RAILWAY ELECTRIFICATION
1037 FORCES BETWEEN PARALLEL ELECTRON STREAMS
1038 COILS FOR THE ELECTRICAL INDUSTRY
1039 DISTRIBUTION CONTROL CENTRE
1042 CABLE LEAK DETECTION
1043 HYDRO-ELECTRIC DEVELOPMENT IN TURKEY
1045 VIEWS ON THE NEWS
1046 PERSONAL AND SOCIAL
1051 INDUSTRIAL NEWS
1053 OVERSEAS ELECTRICAL TRADE
1055 PROTECTIVE TARIFF APPLICATIONS
1056 FUEL AVAILABILITY AND EFFICIENT USE
1057 RURAL DISTRIBUTION
1060 NEW ELECTRICAL EQUIPMENT
1063 FINANCIAL SECTION
1064 NEW PATENTS
1065 NEXT WEEK'S EVENTS
1066 CONTRACT INFORMATION

87 CLASSIFIED ADVERTISEMENTS
96 INDEX TO ADVERTISERS
97 REGIONAL GUIDE TO ELECTRICAL CONTRACTORS

VOLUME 155 ✧ NUMBER 27

Eighty-Third Year of Publication

FRIDAY ✧ ONE SHILLING

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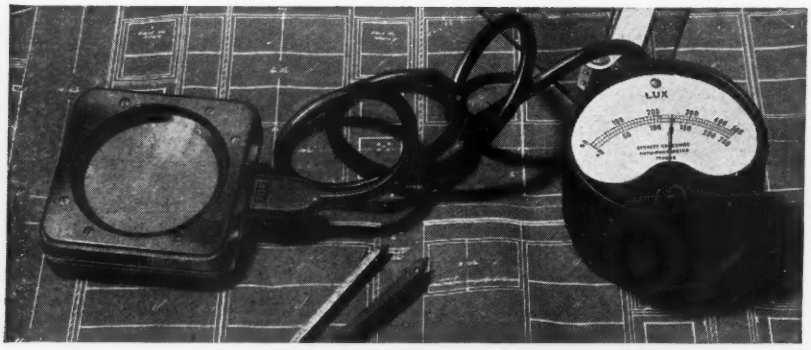

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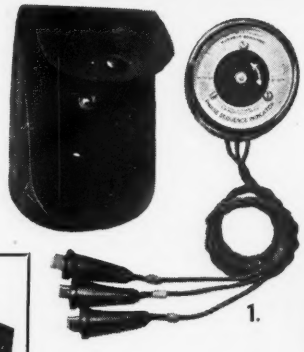

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ELECTRICAL REVIEW

31 December 1954 Vol. 155 No. 27 Established 1872

Generation and Distribution

WHEN the Minister of Fuel and Power said recently in the House of Commons that the electricity supply industry could most effectively help to raise living standards through improved fuel economy and more extensive services in the home and in general industries, he implicitly recognized its two-fold nature.

This differentiation has become progressively more pronounced since the days when lighting provided the chief load of power stations small enough to be situated in urban surroundings and to make no significant call on fuel resources. With their associated distribution systems, they individually formed convenient administrative units, although the statutory powers given to undertakings related only to the supply of electricity, to which its production was merely an adjunct.

Increasing electrification, necessitating the building of larger stations on remoter sites where low-grade coal could be used more effectively, made more evident the cleavage between the two branches of the service. The construction of the 132 kV grid for interconnecting power stations, with its latent conception of a nation-wide integration of generating plant, has now culminated in the 275 kV supergrid for transmission. This evolutionary engineering development to nation-wide proportions is a feature that distinguishes generation from retail distribution.

Another difference is one of approach to the subject. At one time engineers managing undertakings were sometimes held to devote an undue proportion of attention to their power stations and too little to their consumers. The first is now an undisputed merit and the second is no longer a distraction. Problems of modern generation and transmission become more highly technical and the many that still await solution in practice call for all the mental concentration they can get. On the other hand, the chief care of those engaged in distribution is how best to meet consumers' needs.

Popular habits and preferences and trades, together with rural electrification, call for specialized knowledge on the part of the supply authority. Technical developments tend to be based on well-established practice, though the transference lately by the B.E.A. to the Area Boards of some grid lines of under 132 kV may prove an exception. This move is presumably due to the pecuniary savings obtainable by reducing the number of grid bulk supply points formerly required and to the growing number of industries that take high-voltage supplies. Another exception that tests the rule is the statutory power of the Central Authority to supply railways, for the reason that this organization is also nation-wide.

Generation and distribution are thus seen as obverse sides of the same coin, the one producing most cheaply, for the least expenditure of fuel, the electricity required in increasing quantity, partly spontaneously but partly also because of the efforts of those most closely in touch with the public.

AMERICAN IMPORT POLICY

During the past year or two British electrical manufacturers have been disappointed when their low-priced offers of plant to the United States have been rejected under the terms of the "Buy American" Act. Practice has not been consistent for on some occasions, apparently in circumstances no different, such tenders have been accepted. Naturally American electrical manufacturers are not pleased when orders are placed abroad, any more than our own firms would be, but the difference is that British electrical producers (and this country) rely on export trade to keep going while the Americans are not under such compulsion. President Eisenhower is one who realizes this and his recent statement on the subject of Government contracts foreshadows an improvement in the position. Hitherto when American concerns have put in tenders not more than 25 per cent higher than foreign offers they have been awarded contracts. The President has now instructed Government departments to reject tenders from American firms as "unreasonable" if they are 6 per cent higher than those from overseas, including duty and other costs, or 10 per cent excluding those amounts. There is a qualification that the rule shall not apply when American firms operating in "unemployment" areas are concerned.

PRODUCTION COMPARISONS

The December "Bulletin for Industry," prepared by the Information Division of the Treasury, compares production in the countries of Western Europe during the first half of 1954. The increase for all the seven countries included was 8 per cent and this was also the figure for the Netherlands. Western Germany and Italy (both 11 per cent) were above the average but France and the United Kingdom (both 7 per cent) and Sweden and Belgium (both 5 per cent) were below. Comparing production in the various branches of industry, the Bulletin says that the Germans are now exporting about as much non-electrical machinery as we are; within that total, their exports of metal working machine tools are more than double ours but their exports of tractors are less than half. Our lead in electrical machinery exports is appreciable. Nevertheless curves illustrating trends show that during the past three years German exports of this kind have risen much more steeply than similar British exports and are now more than 60 per cent of ours.

A.E.I. AND SIEMENS

A further expansion of the interests of Associated Electrical Industries, Ltd., is implicit in its offer to the holders of the ordinary stock of Siemens Bros. & Co., Ltd. The A.E.I. group already holds £693,150 of the total issued ordinary stock of Siemens Bros.—£3,675,000. By acquiring the substantial remainder, A.E.I. would secure control not only of the large cable and telecommunications business of the parent company but also of a number of subsidiaries including Siemens Electric Lamps & Supplies, Ltd., which produces lamps of all types at Preston, Lancs, and Alfred Graham & Co., Ltd., manufacturers of special telephones and other apparatus. Moreover the Siemens concern has companies in Australia, South Africa and Canada, and is associated with other companies in the production of submarine cables and railway signalling equipment. The offer of £7 of A.E.I. ordinary shares for each £10 of Siemens stock appears to be a fair one and in making it the A.E.I. points out that while its own profits are in the ascendant the present tendency of Siemens' profits is downwards. It is contended that the acquisition will be of common benefit to both concerns.

BOARDS AND COUNCILS

It is a common complaint that Electricity Consultative Councils are too closely allied to the Electricity Boards upon whose activities they are supposed to keep a critical eye. This suspicion (generally unfounded) is fostered by the fact that the Councils' secretaries have hitherto been members of the Boards' staffs. Very wisely the South Western Electricity Consultative Council has now broken away from this practice and has appointed a secretary who is nothing to do with the South Western Board. There is still a link between the two organizations in the shape of the chairman of the Council, who is *ex officio* a member of the Board, but this is a different matter. It is desirable that the Council shall have intimate knowledge of what the Board is doing and what its policies are and this is a good way of ensuring it.

WASTE OF ENERGY

Data brought together by Mr. K. T. Spencer in a lecture, which is reported on page 1056, amply supports his contention that the most obvious way of narrowing the gap between the amounts of coal mined and required lies in a more efficient consumption of energy. The great differences in the best and worst examples cited indicate the magnitude of the scope for fruitful research in this field, which would no doubt reveal inadequate electrification as the main cause in most instances. One example is the 17 therms per ton of earthenware, biscuit fired, of an electric multi-passage kiln compared with 358 therms required for an intermittent up-draught oven. In the more notorious case of the railways there is the contrast of the 4·1 lb of coal of low calorific value used per passenger-vehicle mile by electrified systems and the average of 10·8 lb of large clean coal by a steam train.

COLLIERY POWER CONSUMPTION

There is surely a connection between the 22½ per cent reduction in colliery power consumption of all kinds in the past eight years and the increase since 1947 of about 50 per cent in the electricity purchased from the B.E.A. on account of more economical generation in its large power stations. This result has been achieved despite the great increase in mechanized (i.e., electrified) working. Electrification is not enough, however, unless the means of application are the most efficient, as revealed by Mr. Spencer in comparing the 230 kWh consumed per 100 tons of coal got by one form of continuous mining machine with the 2 kWh required by a coal plough.

Testing Large Synchronous Machines

By S. NEVILLE, B.Sc.(Eng.), M.I.E.E.*

An Explanation of the Wattless-Current Method

RECENT large extensions to the testing plant at the Trafford Park Works of Metropolitan-Vickers Electrical Co., Ltd., provide an occasion for explaining the wattless-current method, which forms the basis of the company's testing practice for large a.c. generators, synchronous motors, and condensers.

The economic importance of works tests can hardly be over-rated, especially in the case of power-station or large industrial plant, where any inadequacy apparent after installation involves disproportionate expense, either of modification on site, or return to the factory, and not least the great cost to the customer of delay in operation. For this reason the specified rating of a machine refers essentially to its performance under service conditions, and it is obviously important to both manufacturer and customer that the capacity and other essential characteristics of the machine be proved before it leaves the factory. In many cases works tests, if clearly adequate and representative of service conditions, may justify the omission of further acceptance tests on site.

In arranging works tests it is not so much high precision as manifest reliability that is important; certainty that the observations relate in a known way to what will be the performance of the plant on site. This principle has long determined the company's normal practice of making full tests on all important plant and all new designs. This article describes some of the equipment that has been built up for this purpose during more than thirty years, with continued extension of capacity, and its application to the several types of synchronous machines.

Large Machine Tests

The primary use of permanent testing equipment is to prove that a machine has the required performance in respect of (*a*) *load characteristics* suited to the intended service, (*b*) *power losses* within the specified limits, and (*c*) *heating characteristics*—under the intended conditions of ventilation—appropriate to the grades of insulation employed. Moreover, a synchronous machine must be considered in conjunction with its *excitation equipment* as a single unit.

Works testing never involves the supply and dissipation of the actual kW or h.p. output of large machines. That would obviously be impracticable for generators of 60 or 100 MW capacity, and is quite unnecessary for a conclusive test. All works testing methods are of the types in which the power expended comprises only the *losses* in the tested machine, plus a comparable loss in testing equipment. Even this can reach an important amount; a 100 MW generator, for example, may have losses of about 1,500 kW, and the total input to the testing plant (with auxiliaries) would be nearly 3,000 kW.

In a *back-to-back* test, two identical a.c. machines are coupled together both mechanically and electrically, as in the well-known Hopkinson test on d.c. machines. By suitable angular displacement at the coupling, it can be arranged that both machines work at rated voltage and current and at rated mean power-factor, thus providing a heating test under actual load conditions. The opportunity for this test rarely occurs in commercial practice, but for research purposes it is invaluable, especially as confirming the reliability of the simpler routine methods.

In a *wattless-current* test, two machines are connected together electrically only; they may differ in every way except working voltage. Voltage is raised to the desired value by excitation of both machines, and rated current at near-zero power factor is caused to circulate by further increasing the excitation of the machine under test and reducing that of the loading machine. Driving power can be supplied by a motor coupled to either machine, or electrically at their common terminals. Actually a generator under test is loaded mainly by reactors, a machine of relatively small capacity serving to adjust the load.

Separate o.c. and s.c. tests are made where for any reason, such as non-standard frequency or unusual voltage, the loading equipment available for wattless-current tests is unsuitable. In each of the two tests, only a part of the full-load loss occurs: on o.c. mainly the iron loss, either at normal or increased voltage; on s.c. mainly the copper loss. These losses being in quite different parts of the machine, it becomes a matter of very careful estimate (supplemented by experience of machines on which full-load tests as well as separate o.c. and s.c. tests have been

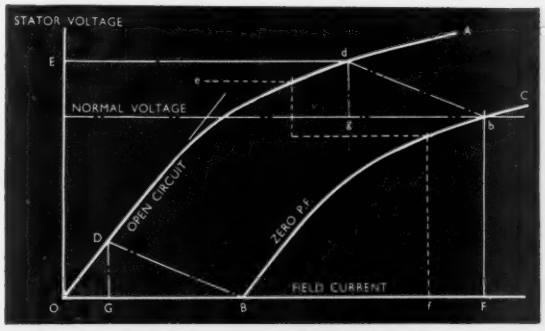
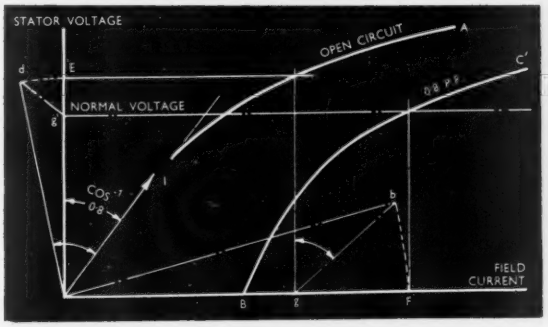


Fig. 1.—Excitation of synchronous machines (Potier diagram): Above (a): zero p.f., Below (b): 0·8 p.f.



* Consulting Engineer, Metropolitan-Vickers Electrical Co., Ltd.

made) to deduce the heating that will occur under service conditions.

Determination of excitation characteristics and losses follows from the methods adopted for heating tests on the several types of machines, which will be discussed first. Although in principle load performance is calculable from tests under two ultimate conditions (the *open-circuit curve*, showing the variations of terminal voltage with field current when the stator carries negligible current, and the *short-circuit line*, showing the ratio of stator current to field current with the stator at negligible voltage), for accuracy in the deductions it is necessary to have also a single reading of field current with the stator carrying both voltage and current at a low power factor, i.e., a *wattless-load point*.

Comparison of Wattless and Normal Power-Factor Loading

The definite correspondence between wattless and normal power-factor conditions may be illustrated by a simple graphical construction. In Fig. 1 (*a*), where OA is the o.c. curve, let BC similarly show the relation of voltage to field current when the stator is also carrying rated current at zero lagging power-factor, OB being thus the s.c. excitation for rated current. It will be found that the two curves are almost identical in shape, simply displaced in a certain direction DB, so that the triangle GDB will fit everywhere between them.*

If (besides OB) any one point is known, such as *b*, where OF is the field current for rated wattless-current at (e.g.) normal voltage, this triangle can be determined. Now it has been fully established by comparative tests, that the height of the triangle (*dg*) can be used as an effective reactance in the stator (known as the Potier reactance), in conjunction with a corresponding armature reaction (*gb*), to predict with all practical accuracy the field current required for any other load or power-factor. For example,

* Strictly, the height of the triangle that will fit becomes a little less with increasing voltage.

Fig. 2a (below). — Loading equipment: 6 and 10 MVA motor generators
Fig. 2b (right). — 21 MVA reactor (removed from tank)

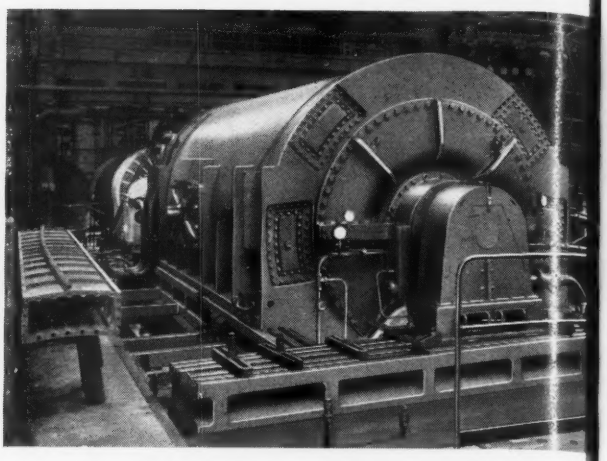


Fig. 3.—A 75 MVA hydrogen-cooled turbo-generator on wattless-load test

Fig. 1 (*b*) shows, to the same scale, the construction for rated load at 0·8 power-factor lagging.

Comparing the two diagrams, it will be seen that OE, which gives an indication of the internal induced voltage, is rather greater at zero power-factor than at 0·8, while the field current OF is considerably greater. If, therefore, a wattless-current heating test is carried out at rated voltage and rated current, the iron loss in the stator core and the copper loss in the field winding will both be greater than at 0·8 or similar power factor, and the machine will be hotter throughout. On the other hand, if the voltage is reduced until the field current is that predicted for normal power factor, the stator core loss (and the total loss) become obviously less than on rated load. A reliable practical policy, therefore, is to make the wattless-current test at such a reduced voltage that the total loss is calculated to be equal to that at rated load and power factor, thus leaving the field current slightly above that at rated load (by a known amount, which can be accurately allowed for in judging the results), and the core loss slightly too low.

Wattless Loading Equipment

The initial installation at Metropolitan-Vickers, in 1920, was a motor-generator set of 6,000 kVA, with two 1,000 kW d.c. driving motors, seen in the foreground of Fig. 2 (*a*). This was supplemented in 1925 by No. 2 m.g. set, of 10 MVA, with two 500 kW driving motors. Both generators are of the solid salient-pole type subsequently developed by this company for many purposes, running at 1,000 r.p.m. at 50 c/s. Both machines are designed for operation at 6·6 kV in delta connection and the windings are arranged for connection in two, three or six parallel circuits for lower voltages and greater currents.

A great increase of loading capacity was made in 1928 by the addition of two large three-phase oil-immersed reactors, Fig. 2 (*b*). The winding on each leg consists of a number of spaced section-wound coils connected in parallel in two groups, which may be connected externally in series or parallel, the phases either in star or delta, and the two reactors again either in series or parallel. In parallel-star each of the reactors had a capacity of 22 MVA at 6·6 kV, or in series-star 15·25 MVA at 11 kV to which they were limited by insulation. Thus the total loading capacity was 60 MVA at 6·6 kV, but 11 kV machines had to be tested in delta connection on account of the voltage limit of the m.g. sets. At this time two large testing pits were available, designed particularly for horizontal-shaft machines (Fig. 3).

On several occasions this permanent plant was supple-

mented by synchronous condensers and other rotating machines that happened to be available. By such expedients a record wattless-load test at 62·5 MVA was carried out on a turbo-alternator in 1930, and another record was established at 75 MVA in 1935.

The recent extensions include two further testing pits, suitable for the erection of large vertical-shaft generators, one being also adapted to mounting very large turbo-alternators. Fig. 4 gives a general view of a waterwheel generator under test in one of these pits. Corresponding extensions of loading equipment include three more reactors of the same size, rated at 22 MVA at 13·5 kV in series-star; and the two original reactors have been reconstructed with this rating and insulation. To enable the motor-generators also to give their combined output at *any voltage* up to that of the reactors, a two-winding transformer of 16 MVA has been installed, with on-load tap-changer giving variation of ratio over the range of 6·6/6·6 to 13 kV. Thus the loading capacity has been raised to a nominal 121 MVA at 6·6 or 13·2 kV. The standard 100 MW turbo-alternator can be tested at 13·4 kV. At 11 kV the capacity is limited to 89 MVA; but 11/12 kV generators can be loaded in delta at 6,700 V up to 125 MVA. Machines designed for 15 or 22 kV can be tested by temporarily connecting the winding in two or three parallel circuits.

Driving power is brought to the testing berths by a 500 V d.c. feeder, and two 6·6 kV a.c. feeders each of 2·5 MVA capacity. The m.g. sets are normally started light from the d.c. supply, through a resistance bank. Alternatively one set, after being brought up to speed in this way, may be synchronized with one of the a.c. feeders, and its d.c. machines then transferred to a busbar from which the other set may be brought up to speed by Ward-Leonard control, even against a large a.c. output.

Turbo-Generators

These machines do not readily develop sufficient torque on a.c. supply to overcome the initial friction of the bearings, and they are usually coupled for test to a d.c. driving motor. Each testing pit is equipped with such a motor and a three-speed gear box. The larger equipment, seen in Fig. 5, has a motor of 2,000 kW capacity running at 600 r.p.m. plus 20 per cent overspeed; and gear ratios 1 : 2½ : 5 enable turbo-generators to be run up to 3,600 r.p.m. The driving motors can be started from the 500 V d.c. supply through a resistance bank, or by Ward-Leonard control from either m.g. already synchronized with an a.c. feeder. This is the condition represented in Fig. 6 (*a*) on the following page.

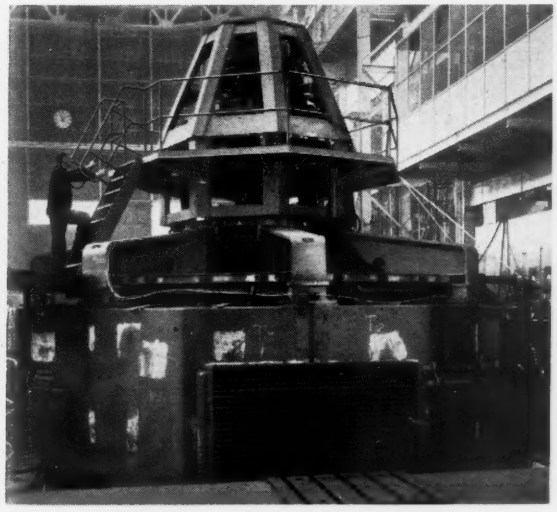


Fig. 4.—A 28 MVA, 136 r.p.m., vertical waterwheel generator in the new testing pit

For tests within the voltage range of the loading machines, the turbo-generator is connected to the necessary group of reactors to give rather less than the required kVA load at the intended voltage of test, and is brought up to speed (unexcited) by the driving motor. On applying field current, voltage and wattless load-current are built up. The second m.g. can then be brought up to speed, synchronized with the turbo-generator, its excitation reduced to increase the load (with simultaneous increase of excitation on the turbo-generator to maintain voltage), and its d.c. side unloaded and disconnected.

Where the test voltage can be exactly 6·6 kV the whole circuit can be synchronized with one of the a.c. feeders, and all d.c. supplies can then be unloaded and disconnected. The m.g. originally used to supply the driving motor can then be brought into use to augment the wattless load if necessary, power being taken from the feeder only at high power factor.

For tests at voltages other than that of the feeders or loading generators, the tap-changer transformer is introduced between the test circuit and the 6·6 kV equipment, as shown *dotted* in Fig. 6 (*a*).

The total losses in the turbo-generator (together with the coupled driving motor and gears) can be measured by the a.c. input at its terminals plus any d.c. input to the driving motor. If power is supplied *only* by the motor, allowance must be made for power output from the turbo-generator to the loading equipment.

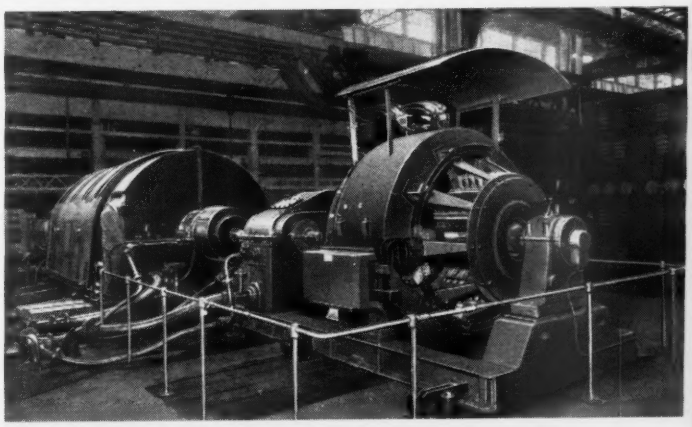


Fig. 5.—A 61·765 MVA air-cooled turbo-generator coupled to 2 MW driving-motor and gears

Waterwheel Generators

Salient-pole machines can usually be started up from a low-frequency a.c. supply. In horizontal-shaft machines, the damper winding generally provides ample torque to overcome initial bearing friction. With vertical-shaft machines, the great weight and large thrust-collar diameter require some means to relieve initial friction. As such machines are usually fitted with hydraulic jacks, the normal procedure is to lift the rotor so that the thrust-collar is slightly clear of the stationary pads, allowing the bearing surfaces to become flooded with oil. Power is then applied to the stator winding, while the jacks are slowly lowered; and at the moment when the thrust-collar rests on the oil film the rotor commences to turn.

To obtain the necessary a.c. supply at low frequency,

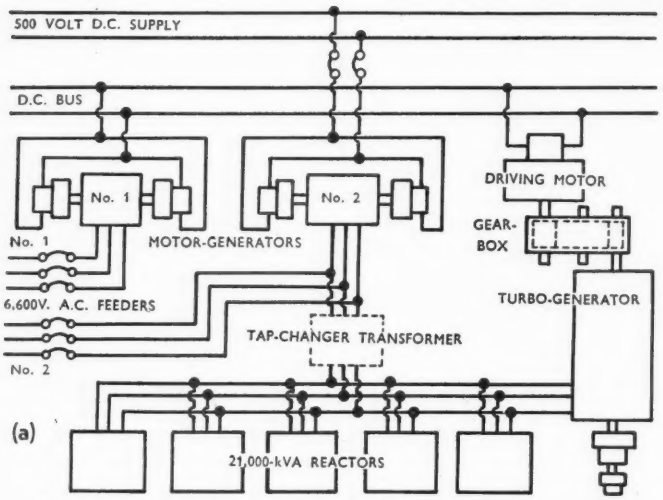
one m.g. set, connected to the generator to be tested and the appropriate group of reactors, is started up slowly from the other set, already synchronized on an a.c. feeder—Fig. 6 (*b*), with strong excitation on the m.g. and the generator field winding unexcited; the generator will commence to rotate (asynchronously) at a very low frequency. At about 10 c/s the m.g. is allowed to slow down and fall into step with the generator, which is then separately excited, and brought up to full speed (in synchronism with the m.g.) by gradually raising the d.c. voltage. At normal speed, excitation can be transferred to the direct-coupled exciters of the machine under test; voltage and wattless load current can be raised to the desired values; the circuit can be synchronized with one of the a.c. feeders and d.c. supply disconnected; and finally the second m.g. set can be added to augment the wattless load if necessary.

Since the generator under test is driven entirely electrically, its total losses are given directly by a measurement of power input at its terminals. Such measurements, however, being at very low power factor (in the region of 0·02) can only be made with the necessary accuracy by specially designed equipment, e.g., a "bridge" circuit with high-grade mumetal current transformers.

Other Salient-Pole Machines

Synchronous motors are tested in the same way as salient-pole generators. When designed for 0·9 or higher power factor, as they often are, the conditions on wattless load differ rather more from actual working conditions than with machines of 0·8 p.f., and the deficiency in core loss and excess in field copper loss are more marked. These differences, however, are definitely known, and the observed temperature rise can be corrected accordingly. The supplementary load loss at a high working power factor will also be rather greater than that included in an input measurement during wattless load test, although less than that measured on short circuit.

For *synchronous condensers*, on the other hand, a wattless current test reproduces exactly the actual operating conditions, with the true total losses—always considerably less than the conventional summation of o.c. and s.c. losses. An additional feature of synchronous condensers (and of many waterwheel generators) is that besides their normal output of *positive* kVar they are commonly required to work alternatively on *negative* kVar (excitation less than for no-load), usually of rather smaller amount, but often at reduced voltage. To load a condenser in this sense only the m.g. sets are available; these machines are not designed for over-excitation, but such tests can be accomplished by connecting the generators as for 11 kV (i.e., in star) when testing a 6·6 kV condenser. By these means, it is possible to obtain a negative wattless load of some 7 MVar; much greater negative loads can, of course, be arranged when another synchronous condenser of similar voltage is available on test at the same time. The practical importance of works tests on negative load is to demonstrate the range and stability of the excitation equipment.



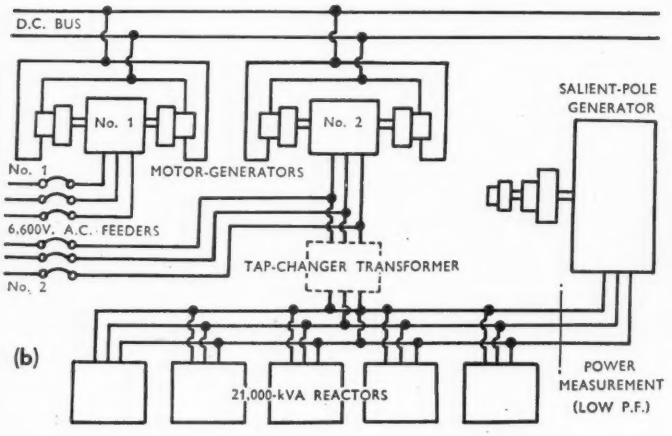


Fig. 6.—Connection diagrams for wattless-load tests: (a) turbo-generator (with driving motor), (b) salient-pole machine (a.c. driven)

Ventilation

Wattless-current loading can closely simulate the heating conditions occurring on rated load; it is equally important that works tests should reproduce the conditions of ventilation that will apply after installation on site. Only minor departures are admissible, of which the effect on temperature rise is obvious and can be reliably allowed for.

Machines of medium size are often installed so that the ingoing or outgoing air, or both, are conveyed by underground ducts. For works tests in such cases, it is usual to close the bottom outlet from the stator, and to provide alternative temporary openings at the top, sometimes with a short chimney to avoid re-entry of hot air. But it is further necessary to insert in the air outlet a screen of wire gauze or expanded metal, so adjusted that the pressure drop across it (shown by a water-gauge) corresponds with the calculated loss in the ducts on site when passing the observed volume of air, after correction for altitude or air temperature.

Larger machines are normally designed for "closed circuit" ventilation, with water cooling of the circulating air. The commonest arrangement has the air coolers in a pit below the machine; the heated air discharged at the bottom of the stator normally divides between two cooler units, each dealing with the inlet air for one end of the machine. Such machines are tested without the coolers, as described for duct ventilation, the restriction of the top air outlet corresponding with the pressure drop through the coolers.

The larger synchronous condensers are built nowadays with air coolers mounted on the sides

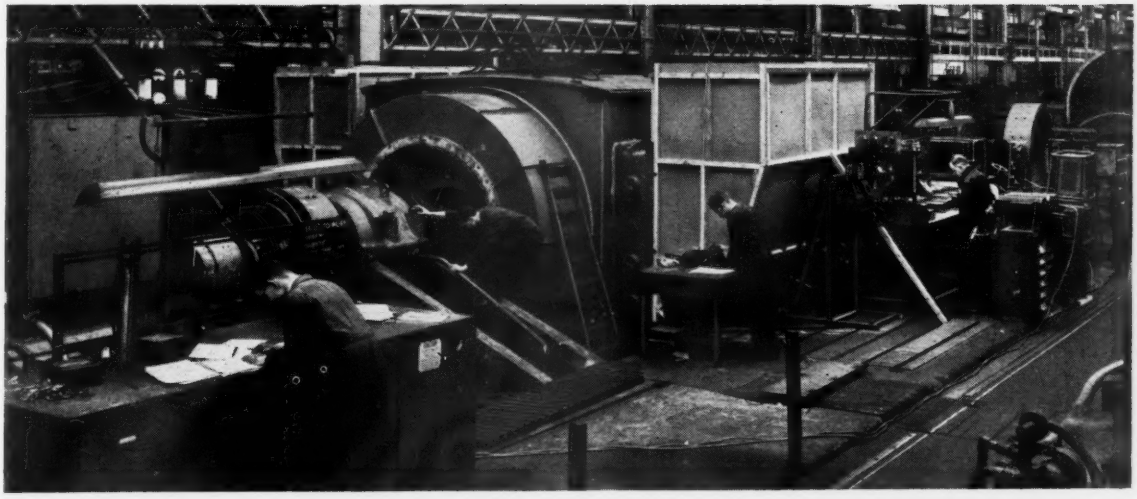


Fig. 7.—A 40 MVA, 1,000 r.p.m. synchronous condenser on full-load test (outer covers removed)

of the stator frame, and the air circuit enclosed by sheet-steel covers wholly above floor level. On the M-V test beds such equipment can be supplied with cooling water, and the heating test carried out entirely under service conditions. Otherwise, the coolers may be retained without water supply, and the outer covers removed, so that cooling air enters from the shop and the heated air is prevented from re-entering by temporary partitions (Fig. 7).

With vertical-shaft generators the enclosure of the air circuit on site is formed by the concrete foundations. For works tests, enclosure is omitted, since the pressure drop in it is negligible. If cooling water is supplied, the outgoing air can be allowed to re-enter the machines; but if cooling water is dispensed with, large barriers are required to prevent direct re-entry of the hot air.

Characteristic Curves and Separate Losses

For *turbo-generators*, which are already coupled to a driving motor, the magnetization curves are taken on open-circuit and short-circuit, the corresponding losses being determined from the d.c. input, with correction for the previously-calibrated losses in the motor and gears.

For *salient-pole machines*, which are driven entirely electrically, o.c. and s.c. tests are replaced by a unity power-factor test and a low-voltage wattless-current test respectively. In the former, the generator is connected to one of the m.g. sets (with auto-transformer if necessary), and brought to a succession of voltages at unity power factor (i.e., minimum stator-current) by adjustment of excitation of both machines. The small stator current (1 to 2 per cent of rated current) has no effect on either the field current or the losses measured at the generator terminals. The second test is made in the same way, except that the m.g. winding is connected for a large current at low voltage. The relative excitation of the two machines is adjusted to produce a succession of wattless current values at a *constant* low voltage, such as 10 per cent normal voltage. Correction for the field current and iron loss corresponding to this voltage is made by reference to the unity power-factor test. The power input readings can be made by ordinary precision wattmeters, provided with compensation for use in the region of 0·1 power factor.

SOUTH AFRICAN NEWS

IN the view of Dr. H. J. van Eck, chairman of the Industrial Development Corporation of South Africa, the provision of atomic power for industrial purposes, particularly at coastal centres, should be considered within the next ten years. Transporting coal from the interior to coastal centres was difficult and expensive, he said. South Africa was the most important producer of uranium in the world and it behoved the Union to play a part in developing its use. They should be careful that they did not lose enthusiastic young scientists to other countries because of their inability to provide an interesting field of activity. It would be well worth considering starting an experimental reactor in the Union.

Electrical Standards

The Council for Scientific and Industrial Research, Pretoria, in its annual report, says that the new d.c./a.c. transfer instrument for a.c. standardization mentioned in the previous report is now in regular use. A technique has been developed whereby the use of the complete scale length can be avoided and the task of the operator simplified by taking all readings at one point on the scale. Equipment has now been built with which any frequency ranging from 1,000 c/s to 10 Mc/s in steps of 1,000 c/s can be derived from the standard with an accuracy which equals that of the standard itself.

As a consequence of disturbing differences noted during comparisons between the existing reference standards of capacitance, a new series of comparisons has been made with a standard recently calibrated by the N.P.L. at Teddington. From this it is apparent that all the air capacitors have maintained their accuracy while the values for the mica capacitors have changed. In future only air capacitors will be used as reference standards.

Progress has been made with the construction of a permeameter. Although magnetic measurements of samples have been made, it is, however, still not in its final form and improvements are being considered. Calibrations undertaken for outside bodies include resistors, pointer instruments, potentiometer/volt ratio boxes, shunts, watches, and time interval meters. In addition tests were carried out on oil and iron samples on behalf of industry.

Engineering in Europe

Abstracts from Foreign Technical Journals

THE impulse-testing of transformers has long been considered essential and these tests have become a permanent feature of industrial practice, but there are still many details of methods and set-ups as well as of results achievable about which the discussion is as lively as ever before. The fact that the fundamentals of the general methods are beyond dispute enables us to get a better appreciation of circumstances complicating the correct evaluation of test results, which at first were rather under-rated in their effects, e.g. the details of the transformer design, particularly where they represent " points of discontinuity " of the winding. Such examples are end coils and regulating turns which, owing to the fact that their natural oscillation frequency is higher than that of the rest of the winding, upset the " normal " voltage distribution along the winding.

A sometimes valuable aid to the " decoding " of oscillograms may be obtained from voltage distribution records based on tests of winding models in the electrolytic tank. The relative merits of full-wave and chopped-wave tests are still controversial, although the absolute value of both kinds of tests is generally admitted. What applies to the use of the method for establishing winding defects, applies in a still higher degree to the possibility of locating these defects more or less accurately, especially in the case of fine punctures which later may develop into serious damage. Again, nobody will deny the usefulness and, indeed, necessity of confirming the results of impulse tests by other methods of which there is no lack. The present state of the art is systematically discussed and amply illustrated in the article.—" Impulse Tests on Transformers," G. Zingales, *Elettrotecnica*, Vol. 41, No. 9, pp. 418–427, September, 1954, in Italian.

Surge Protection

The thunderstorm statistics (1925–47) of the A.S.E. Committee for the Lightning Protection of Buildings list 12,352 cases of damage to buildings, 6,490 of which were due to surges in the electrical installations, only 5,465 being due to direct lightning strokes. This proves that surge protection is as important as lightning protection. On the other hand, even satisfactory lightning arrestor installations in a building containing electrical installations represent a danger in themselves and make surge protection of the electrical system imperative.

The Siemens works have developed special types of their cathode-drop divertors for the protection of electrical installations in buildings, the principle of which is a series arrangement of a quenched-spark gap and a non-linear resistance. The arrangement is built into a plastic casing and provided with a thermal cut-out. These divertors respond without the slightest delay and their protective effect is very impressive, according to an oscillogram showing the reduction of the 283 kV peak of a steep-fronted surge wave to a residual voltage of only 1·8 kV. Many hundred surges of 1 MV peak value can be sustained by these divertors without damage being caused to the apparatus. Particular attention has to be paid to the spacings between the lightning arrestor system and the electric wiring of the building, and also to the placing of the cathode-drop divertors. The principles of the correct layout of the two systems are explained in the article.—" Surge Protection of Consumers' Installations," F. L. Kristofory, *Siemens-Z.*, Vol. 28, No. 7, pp. 309–313, August, 1954, in German.

Concentric Coil Windings

In the operation of synchronous machines current surges produced by short circuits, incorrect synchronization or asynchronous running may subject the windings, and particularly their end connections, to dynamic stresses which the mechanical strength of the coil construction must be capable of resisting. The problem of calculating these stresses can only be solved step by step, by analysing the space-time distribution of the forces exerted on a system of parallel linear conductors carrying currents of equal frequency but with phase differences (in the simplest case two conductors). It is found that in general the field of forces is rotating and takes the form of Lissajous figures, mostly degenerating to ellipses.

In the more special case of a two-pole turbo-alternator the end connections are arranged in three planes, and in four-pole turbo-alternators or salient-pole machines in two or three planes. The end connection of a concentric winding represents a statically indeterminate uniformly stressed framework. The forces acting on this framework are determined on the basis of the maximum short-circuit current to be expected and the framework problem is then solved by the use of a simplified representation. Two methods of solution are suggested, one graphical and one analytical. A numerical example was worked in a concluding article.—" Dynamic Stressing of the End Connections of Concentric Coil Windings," D. Mayer, *E.u.M.*, Vol. 71, No. 20, pp. 473–478, 15th October, 1954, in German.

Shunt Capacitor Installations

The great improvements in the operating conditions in distribution systems obtained by equipping them with shunt-capacitor banks may be partly offset by undesirable phenomena during the switching on and off of the capacitors. This applies to the switching of complete banks as well as of portions of them, or single units. An experimental investigation of all possible cases in the operation of such capacitor banks, in parallel with a theoretical analysis of the various forms of these phenomena, viz., voltage and current surges and travelling waves set up by them, brings this out very clearly and also indicates the measures required for reducing the dangers to the system and its component parts.

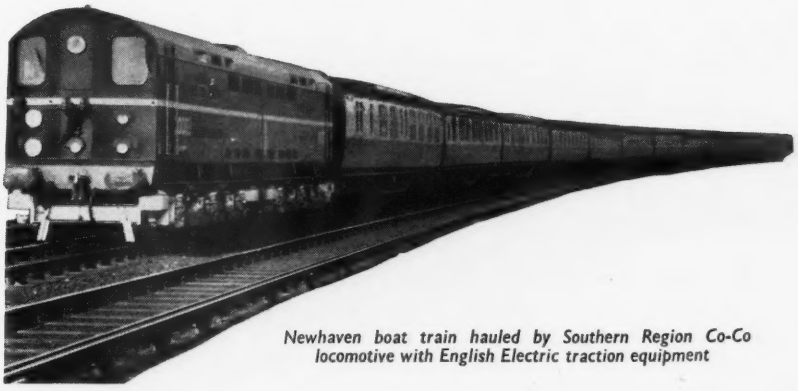
Damping reactors and resistances judiciously placed will go far to avert these dangers, and even more the correct choice of circuit breaker types and ratings. Air blast circuit breakers were found to answer the purpose best, since their breaking speed is of the order required. Particular care has to be given to the correct installation of relay and fuse protection which will respond to internal faults of the capacitor banks, particularly those affecting only the units of one or two phases, since they introduce the serious dangers of ferro-resonant phenomena.—" Switching Phenomena in the Operation of Shunt-Capacitor Installations in Medium-Voltage Systems," H. Prigent, *Bull. Soc. Franc. Elect.*, Vol. 4, No. 45, pp. 513–526, September 1954, in French.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Railway Electrification

THE ENGINE DRIVER'S VIEWPOINT

By B. K. COOPER



Newhaven boat train hauled by Southern Region Co-Co locomotive with English Electric traction equipment

INTEREST in proposals for further railway electrification naturally centres largely on improved services for the travelling public. For the railways themselves schemes of this kind involve problems of training and readjustment of staff to new working conditions. It is sometimes asked whether handling an electric locomotive can offer the stimulus to skill that is so important to efficiency, and in considering this question there must be many who find it hard to give an answer because electric locomotive driving has not yet become the subject of comment and criticism such as that which is published regularly about the daily performance of steam locomotives.

Manchester–Sheffield Line

By chance the first electrification in Great Britain to make extensive use of electric locomotives presented unusual problems in the haulage of heavy loose-coupled goods trains over exceptionally severe gradients. This was the Manchester–Sheffield line, and the special conditions under which it operates are reflected in the electrical design of the locomotives. When the Bo-Bo machines with Metropolitan-Vickers electrical equipment were first placed in service the four weak-field notches were available only in the parallel grouping of the motors, but as a result of running experience the connections were modified to allow field shunting in series as well. The value of this arrangement was demonstrated on a journey made by the writer from Wath to Dunford Bridge in the cab of a locomotive hauling a goods train of 750 tons.

With a second locomotive assisting in the rear, passage through the resistance notches at starting was fairly rapid, but the careful grading of the steps and the skill of the driver were evident in the small variations of motor current during acceleration. Three miles from the start the locomotive was in full series and taking 250 A at 20 m.p.h. on the rising gradient. Advantage was taken of a brief easing of the climb to go into the fourth weak-field notch so as to increase the speed at which the next two miles at 1 in 40 up were begun. Current rose from 500 A to between 550 and 600 A, around which it was held by gradually notching back during the climb. Maximum current noted on the 1 in 40 was 650 A at 14 m.p.h. in weak field 2, and minimum speed 12 m.p.h., by which time the driver had come back to weak field 1 and current was about 550 A.

On the succeeding easier gradients the driver used full field to accelerate his train, and on the main line, with the banking locomotive left behind, went into parallel. Weak-

Left: The French National Railways high-speed Bo-Bo locomotive which hauled the "Mistral" express on the run to Dijon. Right: Goods train headed by Bo-Bo locomotive on the Manchester–Sheffield–Wath electrification scheme

field notches were used again to work the train up to 30 m.p.h., bringing a brief current peak of 700 A, after which the same speed was maintained for most of the rest of the journey by running in parallel full field, with currents ranging around 400 A.

Another modification in these locomotives since they were introduced has been provision for notching back on to resistances when in parallel. Originally the driver had to return his controller to " off " and then notch up again. With the new arrangement it is easier to make brief reductions of tractive effort if slippery rails give a tendency to wheelspin. Although the resistances are liberally rated, drivers are naturally instructed to limit periods of using them as much as possible. There is no doubt that this is well understood, and the fact that " notching back " has been made easier reflects confidence that the facility will not be misused.

On the Southern Region

After this experience in a locomotive with resistance and series/parallel control the writer made a journey in one of the Southern Region Co-Co locomotives with English Electric motor-generator equipment. The run was on the Newhaven boat train, a duty which does not, perhaps, give the best opportunity for demonstrating the flexibility afforded by 26 continuous running notches. On this journey the driver's practice was to notch up as rapidly as possible consistent with observing the normal maximum accelerating current of 750 A, and to limit speed when necessary by coasting. The load was 427 tons.

From Victoria to Balham speed was kept generally around 40 m.p.h. by this procedure but after Balham junction, at 40 m.p.h. and with a clear road, the driver went into weak field. Beyond South Croydon and the end of the busiest part of the suburban area the controller was left on notch 26 and in weak field continuously except when observing speed restrictions at junctions. On such occasions the return to " off " for coasting automatically restored full-field connections. Otherwise the switchback nature of the line itself limits maximum speed without demanding much manipulation of the controls and the highest reached on this occasion was 77 m.p.h.

A loss of 3 min due to a signal check and a slowing for permanent way work was regained in the last 15·5 miles of the run. This capacity for rapid time recovery is particularly valuable on a relatively short journey over a heavily-occupied main line, and would be hard to emulate consistently with a steam locomotive. There is no need to emphasize the importance of exact timekeeping by a " prestige " train such as the Newhaven boat express.

Another point of interest was that on the day of this journey the same locomotive was scheduled to make two return trips between London and Newhaven on boat trains, to haul goods trains from New Cross Gate to Lewes, Lewes to Three Bridges, and Three Bridges to Lewes, and to make various trips between duties running light, the whole amounting to about 372 miles in 24 hours. All the crews concerned would therefore have a variety of work calling for the exercise of considerable skill and judgment.

Experience in France

Up to the end of the war the electric train was generally looked on in Great Britain as a utilitarian means of transport between suburb and town. Its present association with high-speed travel derives from Continental main-line electrification, particularly by the French National Railways. Since 1952 the " Mistral " Paris–Nice express, electrically hauled between Paris and Lyons, has acquired a prestige as high as that of the " Golden Arrow " or the " Blue Train." From Paris to Dijon (195·3 miles) the " Mistral " is booked at an average speed of 77·1 m.p.h., and on being invited recently to travel in the cab on this section of the run the writer was lucky in finding one of the new lightweight (80-ton) Bo-Bo locomotives at the head of the 577-ton train.

In spite of rain, there was no sign of slipping as the locomotive got its heavy train under way. Notching is effected by a to-and-fro motion of the controller, first on the series and the parallel sector of the scale. Each movement of the handwheel makes the electrically-driven camshaft advance one notch. Alternative positions are provided for rapid notching through the whole sequence of 40 steps, but these are used mainly for restoring power after coasting, as drivers have been trained in hand control and prefer it for accelerating a train.

The driver got into full parallel four minutes from the start but remained in full field in order to prevent speed rising above 75 m.p.h. through the suburban area. After Combs-la-Ville (16·1 miles out) the maximum of 140 km/hr (87 m.p.h.) is permitted and further acceleration was effected by using the weak-field notches, of which on this locomotive there are five, going down to 30 per cent excitation.

There are various opinions on the range and gradation of field weakening desirable in a main-line locomotive, and the " Mistral " journey demonstrated the value of flexibility in this respect for precise control of speed and observance of an exceptionally tight schedule. By manipulation of the controller between the first four weak-field notches the speed was maintained closely on the 140 km/hr mark on all the minor changes of gradient as far as Les Laumes Alésia, where the line begins to climb through the Burgundy hills. Here speed was 86 m.p.h. in weak field 3, and current about 400 A per motor. After 5 miles of rising gradients around 1 in 250 the driver had come back to full field, speed being maintained at about 85 m.p.h. with the ammeter down to 200 A. It would have been possible to notch up again for the final stretch at 1 in 125 without exceeding the permitted 850 A, but with time in hand and the incentive of a bonus for economy, the driver was content to remain in full field and allow the gradient to slow the train to 62 m.p.h. at the top. Rapid notching on the succeeding descent soon brought the train up to 87 m.p.h., and, indeed, it was possible to coast at this speed for much of the remaining 16 miles into Dijon. The arrival was dead on time, as might have been foreseen from the driver's nonchalance during the ascent from Les Laumes to Blaisy Bas, which must be a critical stage of the journey when running late.

These examples of main-line work—two on 1,500 V d.c. systems and one on a 660 V line—show that electrification has by no means robbed cab journeys of their interest. The driver's chief concern is the observance of his schedule, and the varying conditions of weather and loading under which he works leave scope for skill in getting the best performance out of his locomotive in different circumstances. The electrical and associated industries can make his task easier by studying the design of controls and instruments, but at present it is a case of providing an expert with the best tools for his job rather than one of gradually reducing the demands on the human element by automatic devices.

For facilities to make the journeys described in this article the writer is indebted to Mr. H. C. Johnson, divisional operating superintendent (western), Eastern Region, British Railways; Mr. T. E. Chrimes, motive power superintendent, Southern Region, British Railways; and Monsieur Pierre Patin, of the Rolling Stock and Motive Power Section, South-Eastern Region, French National Railways.

Forces Between Parallel Electron Streams

A Simplified Approach

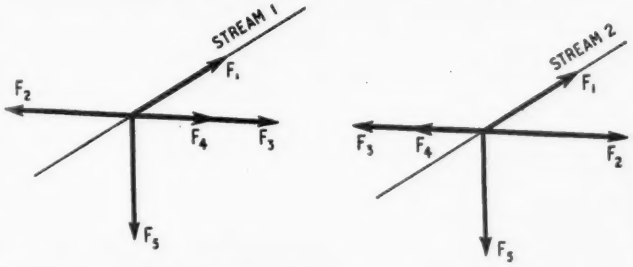
By JOHN WEBB, M.Sc.*

THE behaviour of electrons has some significance for the electrical engineer, for if they did not behave as they do the electrical engineer would find it difficult to earn a living. In this article, the writer, armed inadequately with the mathematics and the outlook of the engineer, has trespassed upon territory occupied usually by the physicist, in pursuit of some fast moving electrons. He must therefore accept the risk of prosecution, but this repellent thought is more than cancelled by the attractive nature of the subject.

Let two streams of electrons travel through space at a distance of D cm apart, and let there be N electrons/cm in each stream. Each stream will constitute an electric current i, where $i = Ne_m v$ ab. amps, in which e_m = the electronic charge $1{\cdot}59 \times 10^{-20}$ electromagnetic units, and v = relative velocity of the electrons in cm/sec.

The forces acting on the streams are: F_1, the accelerating force on each electron stream; F_2, the force of electrostatic repulsion between the streams; F_3, the electromagnetic force of attraction between the streams; F_4, the force of gravitational attraction between the streams; F_5, the force due to the local field, if one exists.

Referring to the diagram, the paths taken by the electron streams are determined by these forces and the convergence or divergence of the paths will depend upon the ratio F_2 to $F_3 + F_4$. The force F_5 has no component in the horizontal plane (in the diagram).



Electromagnetic Attraction

The streams of electrons will each have an associated magnetic field and when the streams travel in the same direction, some lines of force will embrace both streams causing an attractive force F_3 to be exerted between the streams. The magnitude of the force is given by

$$F_3 = \frac{2i^2}{D} \text{ dynes/cm}$$

$$= \frac{2N^2e_m^2v^2}{D} \text{ dynes/cm.}$$

Electrostatic Repulsion

The electron streams may be considered to be infinitely long, parallel, charged conductors. Since the charges are both of the same nature, the force F_2 between the streams will be repulsive. The magnitude of the force is given by

$F_2 = \frac{2q^2}{D}$ dynes/cm, where $q = Ne\rho$ in which $e\rho$ = the charge on the electron $4{\cdot}77 \times 10^{-10}$ electrostatic units, thus

$$F_2 = \frac{2N^2e\rho^2}{D} \text{ dynes/cm.}$$

In the absence of gravitational forces, the condition for parallel flow will be $F_2 = F_3$,

thus $$\frac{2N^2e_m^2v^2}{D} = \frac{2N^2e\rho^2}{D}$$

$$v = \frac{e\rho}{e_m}$$

$$= \frac{4{\cdot}77}{1{\cdot}59} \times 10^{10}$$

$$= 3 \times 10^{10} \text{ cm/sec (emic speed†)}$$

When gravitational forces are considered, the condition for parallel flow becomes $F_3 + F_4 = F_2$.

The force F_4, of gravitational attraction between two infinitely long cylindrical masses, which lie parallel to one another, may be obtained by assuming that there is symmetry between the electromagnetic, the electrostatic and the gravitational force formulæ. This would give

$$F_4 = \frac{2GN^2m^2}{D} \text{ dynes/cm}$$

where G = the gravitational constant $6{\cdot}659 \times 10^{-8}$ c.g.s. units. Consequently the condition for parallel flow is

$$\frac{2N^2e_m^2v^2}{D} + \frac{2GN^2m^2}{D} = \frac{2N^2e\rho^2}{D}$$

from which $$v^2 = \frac{e\rho^2}{e_m^2} - G\frac{m^2}{e_m^2}$$

$$v = \sqrt{c^2 - \frac{G}{\left(\frac{e_m}{m}\right)^2}}$$

The velocity, then, at which the streams will remain parallel is just below emic speed, but so close to this speed that the difference is of no consequence.

The relative mass of the electrons increases rapidly as emic speed is approached, moving mass $= \frac{\text{rest mass}}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$

but even if the relative mass is used in the formula $F_4 = \frac{2GN^2m^2}{D}$, the value of v obtained from the formula $v = \sqrt{c^2 - \frac{G}{\left(\frac{e_m}{m}\right)^2}}$ is then, $v = \sqrt{9 \times 10^{20} - {\cdot}44}$, which is still so close to emic speed that it is obvious that the gravitational forces are infinitesimal. (It is not suggested that the relative masses should be used in:— $F_4 = \frac{2GN^2m^2}{D}$

* College of Technology, Belfast.

† The word "emic" is suggested by the author because of the electromagnetic significance of the velocity 3×10^{10} cm/sec. Light, after all, is but one phenomenon in a general spectrum in which all the components are electromagnetic and share the same velocity of propagation.

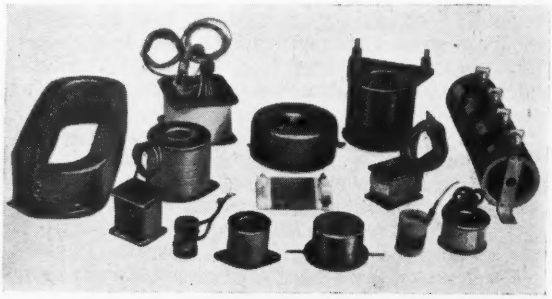
to obtain the gravitational attractive force; in the writer's opinion the rest mass should be used. But it is interesting to note that the mass of the electron would need to be many times greater before gravitational effects would need to be considered.)

At all speeds up to the immediate threshold of the speed of light, the resultant force between the streams of electrons will be repulsive and will cause divergence of the streams. The electrons in a single electron beam will be subjected to scattering, a familiar observation in cathode-ray tubes.

In a conductor there will be as many positive ions as there are negative " free electrons." In the case of currents flowing in the same direction in parallel conductors, the force, then, will be entirely electromagnetic and in this instance attractive. This is easily demonstrated and may be observed in parallel overhead wires during the testing of protective gear when artificial faults are used and large currents are allowed to flow. The same effect causes the bunching together of the fused ore in electrolytic processes and " pinch effect " in mercury arc rectifiers.

Coils for the Electrical Industry

Production to Suit Individual Requirements



Typical selection of coils made by Oliver Pell

MOST engineers will associate Oliver Pell Control, Ltd., with the manufacture of chokes and transformers for the radio industry. To a certain extent the company was built up on this business, but during the last three years the system of planning and production at the Woolwich works has been completely reorganized. The company's main business is winding coils to customers' requirements. When we visited the works recently we were impressed with the wide diversity of coils which were being made in one production unit, a typical selection being illustrated.

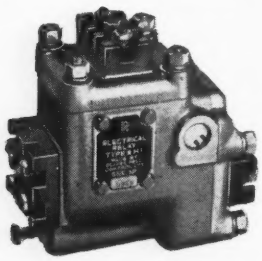


Fig. 1.—High "g" relay for aircraft

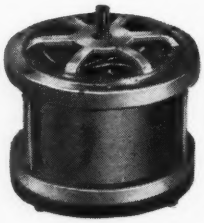


Fig. 2.—Repeater motor made to an American specification

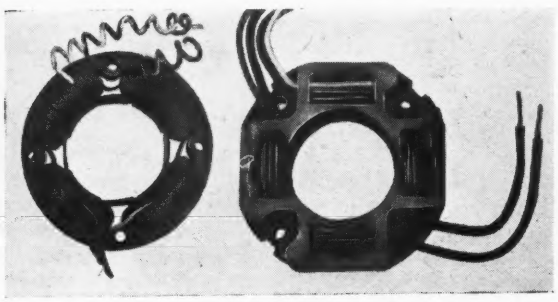


Fig. 3.—Motor stator for use in domestic equipment and (right) Fig. 4.—This re-designed stator reduces production man-hours by 40 per cent

To back up the coil winding side of the business there is a section making transformers to suit individual needs and provided a transformer weighs less than one cwt, large or small quantities of almost any type can be produced. The only standard product is a range of 24 a.c. solenoids and the small ones, the " S.M.A.C." and " S.M.D.C." types, are claimed to be more efficient than equivalent units produced in the United States. These solenoids are built for stock and deliveries of all normal voltages can be made immediately.

The major part of the company's output is concentrated upon what it calls " tailor made electrics." Basically these consist of any piece of equipment in which there is a coil and work on this side of their business is conducted in two ways. Either electro-magnets are made specifically to customers' drawings, such as the high " g " aircraft relay designed by Rolls Royce, Ltd., for use in connection with re-heat on Avon engines (see Fig. 1) or the design office is given details of an item which a company has designed and wants to mass produce, but for which it does not have the capacity.

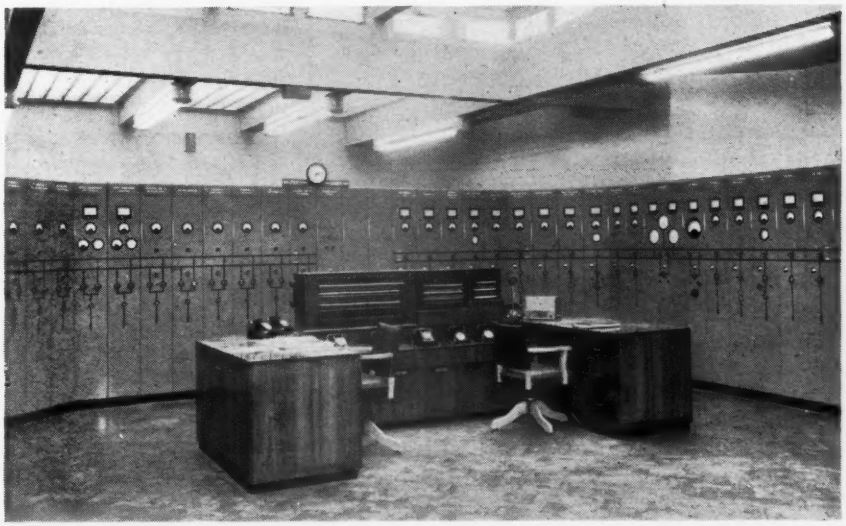
In this sort of case, the company comes into its own, since it has had wide experience in the economical mass production of coil bearing products. An example of this is a motor stator (Fig. 3) for use in an item of domestic equipment in large quantities. The customer wanted a good job that was really economical and he required production to start at once. Thus, the stator was made exactly to his designs.

Meanwhile, Oliver Pell engineers evolved the stator illustrated in Fig. 4. This is much better electrically and, in addition, it incorporates certain wiring which the customer previously had to fit on himself. The man-hours on the job were thereby reduced by about 40 per cent.

Another interesting job we saw going through the works was a repeater motor for a well-known company which is illustrated in Fig. 2. This unit is made straight off American drawings with no modifications. Oliver Pell machines all the parts, winds the coils and tests the unit. It is then despatched to the customer in quantities of about 300 a month at a price which compares favourably with that of the imported American article.

Distribution Control Centre

NEW INSTALLATION AT OCKER HILL



The control room is laid out with the control board in "U" formation, the control desk being between the legs

ON 8th December an official visit was paid by the chairman of the Midlands Electricity Board, Mr. W. S. Lewis, C.B.E., with the Mayors and officials of local Corporations in the Area, to a new distribution and control centre just completed by the South Staffs and North Worcs Sub-Area of the M.E.B. The establishment of this centre was embarked upon following a decision by the Midlands Division of the British Electricity Authority to install two additional 30 MVA generators at Ocker Hill generating station, where portions of the building were occupied by the Area Board's switchgear, transformers and reactors. To allow of the necessary extensions to the power station meant the removal of the Board's 33 kV and 7 kV switchgear, three 33/7 kV transformers and two banks of 33 kV reactors, and the demolition of the old switch-houses and control room.

The existing switchgear arrangements were the result of evolution from a distribution system served by its local generating station to a generating station operated by a Joint Electricity Authority, then directed by the Central Electricity Board and finally owned by the Midlands Division of the B.E.A. Duplication of switchboards existed and the output of two-phase 7 kV generating plant which was being scrapped had to be replaced by extra transformation.

The general design of the new distribution equipment was to consist of four 60 MVA group feeders from the generating station 33 kV busbars to a new 23-unit 33 kV main switchboard to feed existing 33 kV feeders. Existing switch units were to be used wherever possible with the necessary modifications to increase the busbar capacity to 1,200 A, only ten new units being ordered. This switchboard would also supply three house transformers for the generating station and four 33/7 kV Scott-connected transformers. A 7 kV switchboard would also be necessary to control the supply to existing 7 kV feeders.

A new site was made available some 250 yards from the old buildings and a new single-storey building was designed to house the equipment. Because of the large number of cables, h.v. and multicore, that would be necessary between the distribution centre and the generating station a cable tunnel was found to be an economical proposition. Taking advantage of three existing basements, a new tunnel, 150 yards long and 7ft by 10ft in section, was built.

The four 60 MVA group feeders consist each of nine 0·5 sq in 33 kV single-core Henley cables, three per phase, with fire resisting serving. Two group feeders are new throughout their length; two others are extensions of existing group feeders using fully screened single-core straight joints. To keep the fault energy level at 500 MVA reactors were necessary, and existing cast-in-concrete reactors were used. Two banks of the original generating station inter-bus reactors were brought up to the necessary impedance value by the addition of coils, and two others taken from the old group feeders were of adequate impedance, but had insufficient carrying capacity which was increased by the provision of forced cooling equipment.

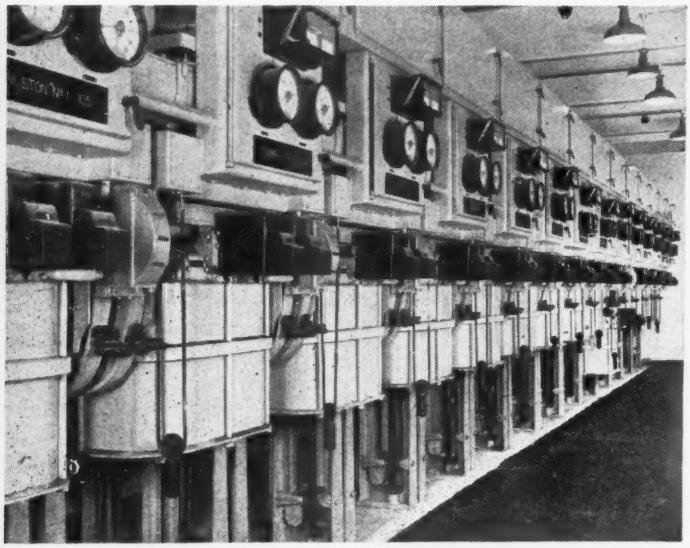
Cooling air is provided by duplicate 13 h.p. fans with semi-automatic control. Thermal images initiate a visual signal when the temperature of either reactor bank warrants the application of forced cooling, and the switching on of a fan motor is visually acknowledged. Visual signals also indicate when a dangerous temperature has been reached or when forced cooling is no longer required. All lamp signals and control buttons for the fan motors are mounted on a special panel in the control board. The reactors were manufactured by the British Thomson-Houston Co., Ltd., and the cooling equipment by Keith Blackman & Co., Ltd.

Cables from the reactors convey power to the main 33 kV switchboard which consists of 23 units of metal-clad gear by Ferguson, Pailin, Ltd., having duplicate busbars of 1,200 A capacity. The four group feeder switches, busbar section and busbar coupler switches are rated at 1,200 A and the remaining units at 400 A.

All feeders are now protected by single element Translay

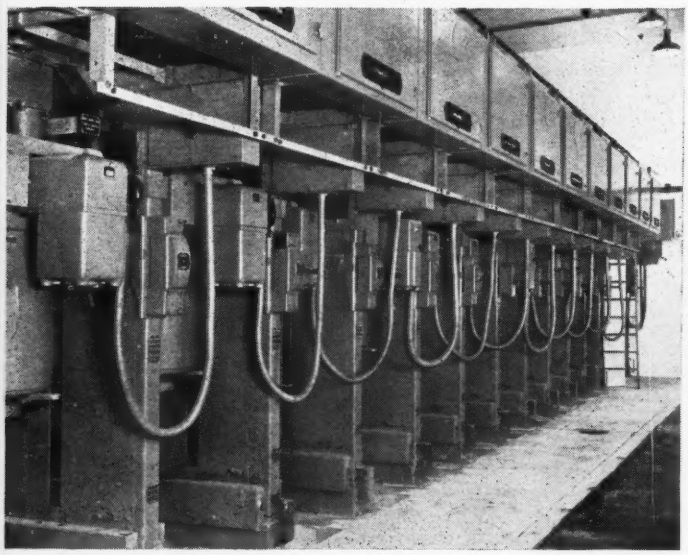
equipment. The reason for supplying the generating station house transformers from this switchboard was to avoid the heavy expense of using 1,500 MVA rupturing capacity switches on the generator main board. Three 400 A switches are provided for this purpose, and from these three groups of three single-core 0·1 sq in cables run along the tunnel back to the outdoor type station transformers.

A scheme of busbar zone protection, based on the Metrovick FV2 relay and designed to operate on earth faults only, covers the whole of the 33 kV gear. The busbar coupler and section switches divide the board into three zones, and the protection is designed accordingly, the necessary overlap being provided on the section and the busbar coupler switches. The busbar zone protective c.t.'s are mounted in the chambers which contain all other protective c.t.'s and this network is continuously supervised by a Metrovick type DBA relay. If a fault on this network is detected by this relay, after a predetermined delay the busbar zone protection is locked out. Intertripping via the Translay pilots is provided on each feeder, so that in the event of a busbar fault no live spouts fed from an external source can be involved in the disturbance.



Portion of the re-erected 7 kV two-phase switchboard

A section of the 33 kV three-phase switchboard



A large part of the h.v. distribution network fed from here operates at 7 kV two-phase, and three Scott-connected transformers, two of 15 MVA and one of 12 MVA capacity, already existed, each having on-load tap changers. A fourth transformer of 15 MVA capacity fitted with on-load tap change gear and Buchholz protection was supplied by Bruce Peebles & Co., Ltd. The three original transformers were moved to the new site, fitted with larger conservator tanks and Buchholz protection, and a new four-panel automatic voltage control board was supplied by Bruce Peebles. This enables either transformer of two pairs to operate as a master or follower. Alternatively, the tap changer of each transformer can be operated by individual push button control. Buchholz gas float operation is indicated on the a.v.c. board, an audible alarm being provided. Surge float operation trips both primary and secondary switches and this is indicated on the control board.

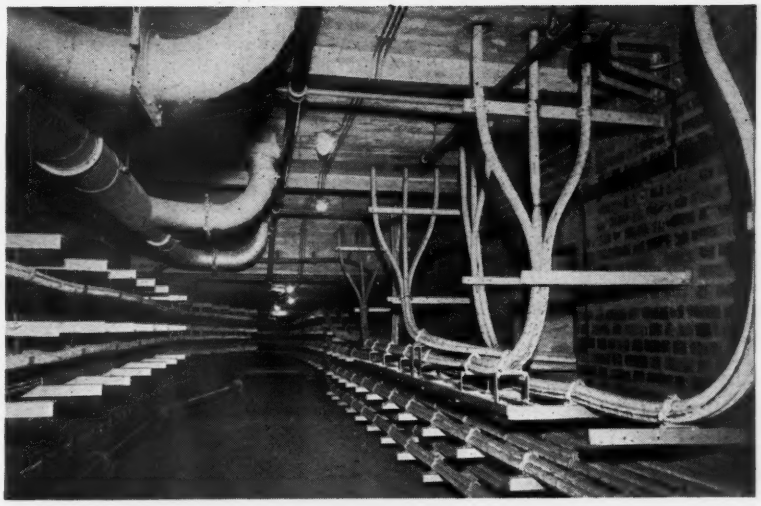
The 7 kV switchboard fed from the four Scott-connected transformers is the existing 29-unit Ferguson Pailin switchboard, originally supplied with hand operation and plain break o.c.b.'s. This was modified before the war by the addition of solenoid operating mechanism and cross jet pots. Each unit was disconnected and removed bodily to its new situation and re-erected. The busbars are in duplicate, one being divided by a busbar section switch. Coupling of the busbars can be carried out at any unit since each tank contains two circuit breakers.

All the control gear, including relay and metering panels, is housed in the new control room which is 32ft by 54ft long. The control board, of sheet steel construction for both 33 kV and 7 kV switchgear, is set in the form of a letter " U " with the control desk between the two legs. It carries the controller handles, mimic diagram and necessary instruments, and is of the normally dark pattern. A small fascia is provided on each panel on which is displayed an illuminated signal in the event of a switch tripping on fault, which indicates the origin of the tripping impulse. An audible alarm is also provided with accept and reset buttons. This annunciation scheme was provided by Standard Telephones & Cables. Separate panels also carry the reactor cooling control equipment and alarms and indication of the operation of the fire fighting equipment.

To avoid the use of busbar voltage transformers a plug selection scheme is provided, using the voltage transformers on the 33 kV group feeder switches to indicate the busbar voltage on each of the three busbar zones. This is repeated on a mimic diagram in the generating station control room, so that the supply to the house transformers can be under the surveillance of the generating station control engineer. Similarly, the alarm annunciations on the house transformer 33 kV switch control panels are repeated in the generation control room.

All relays for 33 kV feeder protection and busbar zone protection are mounted on separate relay boards behind the main control board. The wiring of the secondary circuits between switch units, relay boards and control board is collected in marshalling panels situated in the basement under the main control room. All multicore cables are aluminium sheathed v.i.r. equipment supplied by Johnson & Phillips. An extensive scheme of fixed fire fighting apparatus has been provided.

The design of the new building required to accommodate



The cable tunnel is 150 yd long and 7ft by 10ft in section

the switchgear and auxiliary equipment is roughly in the form of a letter "T." Across the top of the "T" are sited the reactor cells and cooling fan chamber. Behind and parallel with this is the main 33 kV switch-house, divided by the busbar section chamber into two compartments. Behind this and again parallel are the two 7 kV switch-houses, one of them containing the busbar section switch in a separate chamber, the switchgear being arranged in two rows back to back, separated by the intervening wall. One 7 kV switch-house has been made large enough to contain a possible future 11 kV switchboard. All switch-houses have access to the open and are separated by fireproof doors. Telephonic communication is provided from the switch-houses to the control desk. The control room forms the vertical of the "T" with offices, mess rooms, garages and stores ranged along each side. Considerable care was given to the siting and orientation of the building since a large number of cable circuits had to be diverted to it.

At vesting day system control in this Sub-Area was dealt with by three different centres and in different ways. The establishment of the new distribution centre afforded an opportunity to set up a new and unified system control, and this arrangement entailed a high standard of comfort for the staffs which now man the building continuously. In addition to the degree of comfort required by the control engineers, regard was paid to the condition of the switchgear, and a low pressure hot water heating system was installed throughout the building. This is fed from a 200 kW electrode boiler with which is associated a 6,000 gallon thermal storage tank. This is situated in the basement and the small amount of heat transmitted through the lagging is utilized to warm and air the basement and cable tunnel, an injector fan blowing air continuously from the heating chamber into them. The electrode boiler and controls were supplied by G.W.B. Electric Furnaces, Ltd. Thermostats maintain the temperature in the switch-rooms above dew point, an overriding external thermostat compensating for outside atmospheric conditions. A coil of heating pipes embedded in the concrete floor in the vicinity of the control desk maintains a comfortable working atmosphere in the control room.

STAGE LIGHTING

NEW techniques in stage lighting were reviewed by Mr. P. Corry, managing director, Watts & Corry, Ltd., and Manchester branch manager of the Strand Electric & Engineering Co., Ltd., in an address to a joint meeting of the Liverpool Centre of the Illuminating Engineering Society and Merseyside members of the British Drama League in Liverpool on 14th December.

Mr. Corry said that in stage lighting it was essential to create highlights, shade and colour, and to use them to supplement the creation of the set. To be successful in this there must be precise control of light intensity, strength and spread, and at the same time complete flexibility in the operation of equipment. The techniques were similar to those adopted by the painter and the sculptor.

The two main types of lighting used were the floodlight and spotlight. In both of these there was a formidable range of types and sizes of lanterns and many had been created through producers asking for lighting for a particular purpose. Provision had to be made such that direction and angle of cut-off could be altered to suit various needs. Control of direction was extremelyi mportant.

Battens and fixed floodlighting were largely superseded because they were restricted in direction and in the overall spread of light. Individual floodlights and spotlights were being found increasingly useful because they could be moved.

The modern batten was a row of floodlights fastened together, and here intensity could be controlled but not the direction. Intensity from "full up" to "complete black out" could be controlled from the dimmer board. To be ideal there must be a dimmer in every circuit. With the group circuits dimmers for different circuits could not be used at different times. In some recent installations in the professional theatre there were as many as 140 to 250 individual circuits, each with its own dimmer. Thus the switchboard was becoming more and more complicated and some were as big as 17ft by 8ft by 3ft. It was possible for one man to control up to 400 circuits; in one London theatre, one man controlled 200.

Mr. Corry said that colour in stage lighting usually aroused great interest, but it was of less importance than direction control. If the third-dimension effect was to be created, light must be used to create light and shade. It was found that surprisingly good effects could be achieved by using a certain amount of light intelligently rather than using twice the amount unintelligently.

Mr. Corry demonstrated what could be achieved on the stage by skilful use of colour lighting, ultra-violet lamps and mercury vapour lamps and cyclorama, the system whereby still cloud or moving cloud effects could be achieved by projecting the painting or picture from a lantern, perhaps fitted with a motor. To obtain a picture of the correct size, care had to be exercised in positioning the equipment correctly to ensure good focus.

CABLE LEAK DETECTION

Accurate Method Using Radon

IN an article entitled "Gas Control on Telephone Cables," which was published in the *Ericsson Review* (No. 4/1952), a new method was described by means of which, on the occurrence of a leak, gas is fed into the cable automatically, simultaneously with the gas control, while at the same time the drop in gas pressure is recorded.

A new application of this method for the accurate location of leaks is now announced, using radon or radium emanation. Radon, Rn, or radium emanation, is the next transmutation product after radium in the uranium-radium chain. Unlike other radioactive transmutation products it is gaseous. The table shows the periods and forms of radiation of the radioactive products obtained.

Substance	Form of radiation	Period
Uranium I	α	5,000 million years
Uranium X_1	β, γ	25 days
Uranium X_2	β, γ	1 minute
Uranium II	α	2 million years
Ionium	α	100,000 years
Radium	α, γ	1,700 years
Emanation (Radon)	α	4 days
Ra A	α	3 minutes
Ra B	β, γ	27 minutes
Ra C_1	β, γ	20 minutes
Ra C_2	α	$1{\cdot}5 \times 10^{-8}$ seconds
Ra D	β, γ	20 years
Ra E	β, γ	5 days
Ra F	α	5 months
Ra G (Lead)	none	

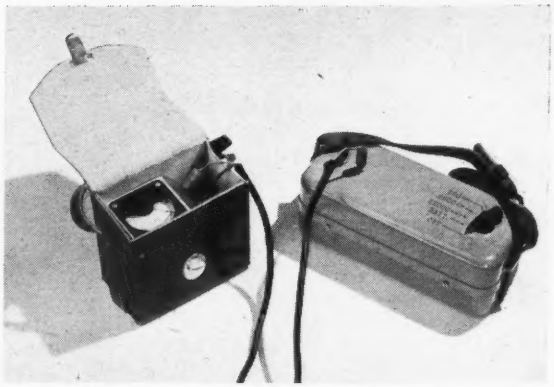
Only the γ-rays are of significance for accurate localization. At the point of fault where the radon gas penetrates into the ground or into the air surrounding the cable, the direct β-rays may be indicated in certain cases. On the other hand, the range of the α-particles is too short to allow them to produce a deflection on a radiation intensity meter.

Radon can be purchased from large hospitals in ampoules 1 to 2 cm long and about 1 mm in diameter. The ampoules sold have already been used for medical purposes and are, therefore, relatively cheap. Fault location is carried out by using a radiation intensity meter, consisting of a radiation detector and a radiation indicator.

The detector is housed in a weatherproof metal casing and is equipped with a change-over switch for three different sensitivity ranges and for controlling the battery voltage. It measures 21 cm by 8·5 cm and weighs only 1·75 kg. The radiation indicator is a pointer instrument calibrated in radiated impulses per minute, which is housed in a leather carrying case.

Injection of the radon is carried out with the aid of a cylinder of nitrogen and a pressure unit. One end of the cable or one of the joints is selected for the point of injection. To inject the gas into the cable the ampoule is crushed and the radon is passed into the cable with the gas stream. It then moves in the form of a plug towards the leak. This plug becomes very attenuated during its passage through the cable, but its front end is always clearly marked. In long-distance cables the injection should preferably be made at the joint nearest to the calculated point of the fault. Where shorter cables are in question, or where it is undesirable to excavate round the joint, inspection can take place from one end of the cable.

A beginning may be made in locating the fault about half-an-hour after making the injection. For this purpose the radiation detector, equipped with a Geiger tube, is moved along the ground over the cable. Owing to the cosmic radiation the pointer will always give a certain deflection over the scale. The radiation from the radon in the cable will always be clearly visible, however, and a strongly marked maximum emission will be indicated at the leak. It will sometimes be found helpful to dig a number of control pits down to the cable from which the emission is particularly strong.



Radiation intensity meter

The above method has been applied both to long-distance cables and to armoured lead-covered cables in urban networks. On the other hand it is not suitable for cables laid in ducts. In this case, however, by means of approximate location and with the help of a gas flow direction indicator the position of the leak can be determined to within a cable section between cable pits. After drawing out the cable the fault can be located in the ordinary way by using soapy water.

On the conclusion of the injection, the piece of hose cut off should be buried, together with the crushed gas ampoule and the protective gloves. Although there is no risk involved to persons carrying out this form of fault detection according to the directions, it must be borne in mind that radioactive substances must be handled with a certain caution.

The intensity of a radioactive substance is usually measured in millicuries (mC), one curie corresponding to $3{\cdot}7 \times 10^{10}$ disintegrations (nuclear transmutations) per second. The shorter the period is, the greater will be the intensity. The radiation dosage, i.e., the quantity of emitted gamma-rays absorbed by the body, is measured in röntgen (r) or mr (one röntgen is the amount of radiation that produces an ionizing effect in 1 c.c. of air which is so great that the total charge of the ions produced is one e.s.u. of each sign).

The maximum permissible dosage for the vital parts of the body is 100 mr, whereas the hands can withstand up to 1,000 mr per week without risk. The ampoules used for detection usually have an intensity of 10 to 15 mC. Since one curie gives an emission of 2 r/h/m the emission obtained in this case will be 20 to 30 mr/h/m. Thus at a distance of one metre from the preparation 100 mr per three and a half hours is obtained, and at a distance of half a metre the same emission in a quarter of the time. The intensity is inversely proportional to the square of the distance.

Thus as great a distance from the ampoules as possible should be maintained during transport and the ampoules should not be handled before their proper use. Nor should they be handled by unskilled persons. Apart from these precautions there is no reason to fear the use of the method described in this article.

Hydro-Electric Development in Turkey

Five Schemes to Afford Generating Capacity of 430 MW

THE following notes relate to five hydro-electric projects which are under construction or projected in Turkey to afford a total additional generating capacity of about 430 MW.

Sariyar Scheme

The project (map reference No. 3) is a multi-purpose development involving, in the main, the construction of a dam across the Sakarya River at a point about 160 km north-west of Ankara, a generating station, and a power transmission system. The dam will be a straight concrete gravity structure with a gated overflow section as an integral part of the dam. The power station is to be situated about 4 km down stream of the dam, after a curved section, and a power tunnel will feed the power house.

The following are the principal dimensions of the dam: height, 106 m; dam crest, 250 m; spillway capacity, 7,500 cu m/sec; concrete volume, 550,000 cu m ; reservoir capacity, 1,600 million cu m; reservoir area, 8,000 hectares. The power conduit has a capacity of 240 cu m/sec, a diameter of 8·40 m, and a length of 931 m. The power plant will have an initial capacity of 80 MW and an ultimate capacity of 160 MW with an annual output of 400 million kWh. The Sariyar dam and its related structures are now being built and they will be completed in 1956. The project will supply power to the North-West Anatolian Region and relieve the floods of the Adapazari Plain. The total cost of construction including substations and transmission lines between Sariyar and Adapari, Sariyar and Ankara, and Catalagzi and Karabuk is estimated to be about £T207 million. About $27 million is the foreign currency requirement of the project. The construction of the dam and power plant was awarded to a Turkish-German group in 1951.

Hirfanli Project

This project (map reference No. 21) involves the construction of a dam across the Kizilirmak River approximately 80 km upstream from Kirikkale, flood control works, a generating station and a power transmission system. The dam will be a rock-filled structure with a solid core, with a channel type spillway around the right abutment and with gates for regulating seasonal flood flows. The power house will be situated on the right bank and served by two tunnels. The dam will have a height of 85 m and a crest length of 430 m. The spillway capacity will be 2,000 cu m/sec; and the amount of rockfill 2,500,000 cu m. The reservoir capacity will be 6,300 million cu m. The power station will house four 25 MW turbo-alternators, the annual output of which is likely to be 400 million kWh.

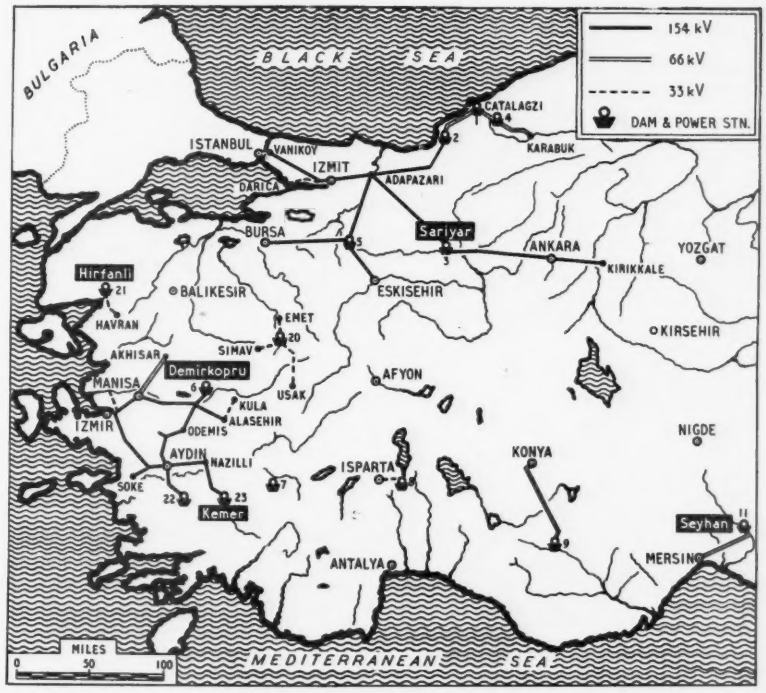
The general Hirfanli dam structures are already under construction and will be completed in 1958. The scheme will supply power to the North-West Anatolia power system and to Central Anatolian cities and towns, and it will reduce the severity of the Kizilirmak River floods. The total cost of the construction including the step-up transformer substation is estimated at £T100 million. Foreign currency requirements to the extent of £6 million is secured by Turkish Government Treasury bonds which will be liquidated in nine years. The construction of the dam and power plant is in the hands of an English group, namely, George Wimpey & Co., Ltd., and the English Electric Co., Ltd.

Development of Demirkopru

The Demirkopru scheme (map reference No. 6) involves the construction of a dam across the Gediz River about 25 km north-east of Salihli, flood control and irrigation works, a generating station and a power transmission system. The dam will be an earth structure with a flood spillway in the left abutment, and the power house will be at the end of a tunnel.

The dam will be 505 m long and 77 m high, and the spillway, which is partly gated, will have a capacity of 7,100 cu m/sec. The reservoir capacity is 1,600 million cu m. The steel and concrete tunnel will have a diameter of 6 m and a length of 2,600 m.

The plant capacity will be 69 MW in three sets and the annual output will be about 193 million kWh. The Demirkopru dam structures are now under construction in the Gediz Valley and will irrigate 78,000 hectares of land and will prevent floods. The total cost of the construction,



Among the many hydro-electric schemes completed, under construction and projected in Turkey there are five depicted with a total generating plant capacity of about 430 MW

£T = £ sterling.

including a step-up transformer substation, is estimated to be £T75 million. This demands foreign currency of $15 million which will be secured by Turkish Government Treasury bonds to be liquidated in nine years. The construction of the dam and power plant was awarded to a Turkish-French group called E.M.C.-Rar in April this year.

Seyhan Scheme

This project (map reference No. 11) embraces the construction of a dam across the Seyhan River about 8 km north of Adana, flood control and irrigation works, a generating station and a power transmission system. The dam will be an earth structure with two spillways (one of which is an emergency spillway) on the left abutment and a power house at the end of a tunnel on the right abutment.

The dam is 57 m high and 1,955 m long. The main gated spillway has a total capacity of 3,400 cu m/sec and the quantity of earth used for filling is 7 million cu m. The reservoir capacity is 1,400 million cu m. The tunnel, which has a diameter of 8 m, permits a flow of 120 cu m/sec; it has a length of 585 m. The ultimate plant capacity of the power station will be 54 MW and the annual output is likely to be 284 million kWh.

The Seyhan dam structures are now under construction and will be completed in 1956. The project will irrigate 144,000 hectares of land in the Cukurova region and it will protect this land from floods and supply power to industries in the region.

The total cost of construction, including the Adana–Tarsus–Mersin transmission lines and substations, is estimated to be £T96 million and the foreign currency requirement of $25 million for this is secured by the International Bank for Reconstruction and Development. The construction of the dam and power plant was awarded to the Turkish-American Morrison Kundsen-Garanti group in 1953.

Kemer Scheme

The Kemer project (map reference No. 23) calls for the construction of a dam across the Akcayi, a tributary of the Buyuk Menderes River about 45 km south of Nazilli, flood control and irrigation works, a hydro-electric generating station and a power transmission system. The dam will be a straight concrete gravity structure with sluice-ways through the base. There will also be an emergency spillway situated in a low saddle behind the right abutment of the dam, while the power station will be situated at the toe of the dam. The dam will be 109 m long and 310 m high, and the spillway capacity will be 5,000 cu m/sec. About 700,000 cu m of concrete will be used in the construction of the dam. The resultant reservoir capacity will be 544 million cu ft. The power station will have a generating plant capacity of 48 MW and the annual output will be about 143 million kWh.

Work on the Kemer dam structures is proceeding and will be completed in 1958. The project will supply power to cities, towns and industries in the Gediz and Buyukmenderes valleys and will irrigate 38,000 hectares of land. The total cost of the construction including a step-up transformer substation is estimated at £T70 million. This requires foreign currency of $10 million which is to be secured by nine-year Turkish treasury bonds. The construction of the dam and power plant was awarded to the Turkish-French group E.M.C.-Rar in April last.

Ontario's Power Resources

LAST year the Hydro-Electric Power Commission of Ontario added 212 MW to the dependable peak capacity of its resources, making the total 3,565 MW. This was mainly the result of new generating facilities at the Otto Holden hydro-electric and the Richard L. Hearn and J. Clark Keith steam stations. Owing to the fact that water conditions were almost the lowest on record and that a serious fire occurred at the Chats Falls station, the Commission had great difficulty in meeting the Province's increasing power requirements resulting from large-scale industrial expansion and the growing level of prosperity generally. It succeeded in doing so only by being able to draw on the two major steam stations and make full use of interconnections with the Detroit Edison Company which were inaugurated during the year.

In a foreword to the Commission's forty-sixth report, the chairman (Mr. R. H. Saunders) reviews the events that made the year one of significant achievement. These included, besides additional plant at the three stations already mentioned, authorization of a pumped storage reservoir and four additional units at the Sir Adam Beck No. 2 project which will give an ultimate development there of 1,828,000 h.p. (the initial installation at the station was officially opened by the Duchess of Kent last August); authorization of the Commission's 15th post-war project (Manitou Falls); authorization of extensions at Pine Portage station; development of a remedial scheme to preserve and enhance the beauty of the Niagara Falls; completion of the change-over of supplies to one-third of the total number of consumers under the frequency standardization programme; and the start of "feasibility studies" in co-operation with Atomic Energy of Canada, Ltd. Good progress was also made in negotiations for the St. Lawrence power project, on which agreement has since been reached.

Referring to the Sir Adam Beck–Niagara No. 2 generating station as "an engineering achievement unsurpassed," the report says that the Niagara River will shortly become the greatest concentration of hydro-electric power in the world, taking into consideration developments on the United States side. The total amount of electrical energy which will be available to the Commission from Niagara River water, upon the completion of the authorized developments, will be about 12,000 million kWh per annum. The Sir Adam Beck station has been built in the face of 300ft cliffs along the Lower Niagara Gorge. To convey water to the station twin tunnels 5½ miles long and with a finished diameter of 45ft have been constructed under the city of Niagara Falls.

After ten years of electrical service under a uniform rate structure the Commission has increased its rural primary distribution lines from 20,087 to 41,589 miles and the number of rural consumers from 136,164 to 371,855. In 1953, each farm customer consumed on an average 3,885 kWh compared with 2,199 in 1945. The cost of electricity to the farmers, although it has risen from 1·900 to 2·164 cents since 1945, remains less than before the war (2·56 cents in 1939).

The average price paid by domestic consumers last year was 1·155 cents/kWh against 1·074 cents in 1945 and 1·259 cents in 1939. Each domestic consumer used on an average 4,404 kWh in 1953.

Financial Operations

A combination of the increase in sales and the effect of the upward revision in charges brought about an increase in total gross revenue of the Southern Ontario system from $96·7 million to $117·6 million. Costs were correspondingly higher, largely as the result of the greater use of fuel-electric generation and of higher labour costs. The total cost of providing service in 1953 was $116·5 million after withdrawing $0·8 million from the reserve for stabilization of rates, as compared with a cost of $94·9 million in 1952, after the withdrawal of $2 million from the same reserve. There was a net surplus on the system's rural operations of $78,455. The Northern Ontario Properties' accounts show a gross revenue of $19·4 million, the rise in revenue being somewhat larger than the increase in expenditure.

Capital expenditure during 1953 amounted to $183·6 million, of which approximately 64 per cent was spent on generating facilities.

VIEWS on the NEWS

By REFLECTOR

SIR Jocelyn Lucas suggested to the Minister of Works last week that there should be at least one coal fire in the Palace of Westminster. He said that since the abolition of coal fires there was no way in which a chilled member arriving from the country could thaw out. The Parliamentary Secretary to the Ministry (Mr. Bevins) said that a temperature of 69 deg F was maintained in the members' writing room by central heating and there was also an electric fire there. Sir Jocelyn said that " the electric fire had no heat because it had no heater," but Mr. Bevins denied this and said that the electric fire could raise the temperature of the room to 75 deg—enough to thaw out anyone. One electric fire (with a problematical " heater ") seems to be a small allowance for these extensive buildings. Presumably the central heating system is supplemented mainly by heated debates.

* * *

I recently mentioned that the Greenock Town Council had decided to prevent Council house tenants who were in arrears with their rent from installing grates and immersion heaters or erecting wooden huts in their gardens. A proposal that television aerials should also be banned was withdrawn. I suggested that this was thought to be going too far but the Devizes Rural Council is made of sterner stuff. It has decreed that its tenants must be up to date with their rent before they will be given permission to erect television aerials.

* * *

At a time when there is so much concern at the insufficient number of recruits to the ranks of technologists and engineers it is surprising to learn that it is quite otherwise in the medical profession. Mr. R. L. Newell, writing in the Manchester University's " Medical School Gazette," says that, after allowing for normal wastage through death and retirement, there is an excess each year of registrations over recruitment of several hundreds. He estimates that by 1959 there may be between 5,000 and 6,000 redundant doctors. Although medical science differs in kind from the knowledge which physicists, chemists and engineers must acquire, there is no doubt that medical students are likely to have scientific minds. It seems worth while to ask some of those who contemplate a medical career whether they do not think that a technological career would satisfy and reward them equally well.

* * *

British Railways are evidently (and justly) proud of their Manchester-Sheffield-Wath electrification which is now meeting with such remarkable success in the way of increased traffic. The London Midland Region has produced a large coloured poster showing two of the new locomotives—one hauling a passenger train, the other coal trucks—on the line between Hadfield and Woodhead. This is proudly claimed to be " Britain's First All-Electric Main Line " and the text of the poster mentions that there are now in operation seven 2,760 h.p. Co-Co locomotives for the passenger service and fifty-eight 1,868 h.p. Bo-Bo locos for freight. Over the Manchester-Sheffield main line there are about 100 trains each way daily, nine-tenths of them coal trains. The Manchester, Glossop and Hadfield suburban service is provided by multi-unit trains. This scheme should have a profound influence on the decision which British Railways must soon make on main-line electrification.

* * *

Birds and beasts are often the cause of electrical faults in this country but in India they seem to be active all the time—perhaps because there are more of them and they are not so electrically educated. I am told that a G.E.C. engineer in India recently had to report on the causes of the frequent tripping of an oil circuit breaker on an overhead line. One trip seemed to have been due to the dropping of a piece of wire by a passing bird and others were attributed to the suicide of three monkeys, a squirrel, two eagles and a crow. The list was headed by the cryptic phrase, " Vulture on Blue Phase." Whether this implied the death of the bird or merely its watchfulness at a scene of so much animal slaughter was not clear. The same engineer had trouble while commissioning a new alternator. He traced it to the work of a crow which had secured strips of metal from a neighbouring tinsmith's and built a nest with this material across the line.

* * *

Automatic " speed walks " for pedestrians, pavements raised to first-storey level, a device for the distant prevention of atomic fission, and control of domestic heating and ventilation by covering houses in a plastic shell, with a larger one over the whole of London, are some of the forecasts for the year 2000 A.D. made in a competition to mark the bicentenary of the Royal Society of Arts. For the sake of city dwellers of that day I hope that the headline in the *Glasgow Herald*, " A Plastic *Doom* Over London " is at any rate not prophetic. Just Scottish dialect perhaps?

* * *

Electricity for the irradiation of plants to stimulate their growth is quite common nowadays. Sixty years ago it was thought that magnetism had some influence in this direction, as witnesses the following paragraph from the *Electrical Review* of 28th December, 1894:—

> " We have frequently alluded to experiments which have been made with magnetism on the germination of seeds, and have often regretted that accounts of such investigation which have been available have not contained quantitative data as to the strength of the magnetic field, etc. Had such data been given it might have been possible to account for the conflicting results which different observers have obtained when experimenting with the same seeds. In *Malpighia* vii. (1894) pp. 470–482, there is an account of some recent researches by G. Tolomei on the effects of magnetism on the germination of *Phaseolus vulgaris*. He found that a magnetic field of feeble intensity had no appreciable effect on the germination of the seeds, whilst a field of greater intensity caused more or less increased rapidity of growth in proportion to the proximity of the growing seeds to the point of greatest magnetic intensity. Young plants he found to be diamagnetic. We are sufficiently grateful for such distinctions as *feeble*, *greater*, and *greatest* intensity; but when will these gentlemen, who are so interested in the effect of magnetism and electricity in plant life, be kind enough to accompany their results with quantitative data which may be made to convey something like an accurate notion of the conditions of experiment? "

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. G. Stanning, M.B.E., works manager of Allen West & Co., Ltd., has retired and at a recent ceremony he was presented with a gold cigarette case and a wallet from the directors, a gold wrist watch for himself and a gold wrist watch for Mrs. Stanning from the staff, including the foremen and charge-hands, and a clock and a gold cigarette lighter from the works employees. The presentations were made by Mr. Victor Breeze (managing director). Mr. Stanning joined Allen West & Co. at the age of twenty-one as a fitter, became works foreman in 1920 and works manager in 1934.

The new works manager is **Mr. R. McGregor Malloch,** who has been Mr. Stanning's assistant since 1940. After experience with the English Electric Co., Ltd., and the General Electric Co., Ltd., he joined Allen West & Co. in 1931, being engaged on the design of traction gear. Early in the last war he worked on radar equipment for the Admiralty at Portsmouth, but returned to Allen West in 1940 as assistant works manager.

Mr. J. Meek, at present secretary of the South West Scotland Electricity Board, has been appointed secretary of the newly formed South of Scotland Electricity Board. Before joining the South West Scotland Board in 1948, Mr. Meek was town clerk depute, Glasgow, a position he had held since 1937.

Mr. J. Meek

Mr. H. C. Thomas, director and secretary of the Northern Aluminium Co., Ltd., has retired.

Mr. Colin Adamson, lecturer in electrical engineering at Manchester College of Technology, is to give a six weeks' course at the University of Roorkee, Uttar Pradesh, North India, in January and February, on "Power System Stability." His visit is under the auspices of the British Council.

Captain (L) R. C. Wield, C.B.E., M.I.E.E., R.N. (ret.), has been appointed secretary of the South Western Electricity Consultative Council. Until his retirement from the Royal Navy last year Capt. Wield was deputy director (material) of the Naval Electrical Branch, which is responsible for the maintenance of the Fleet's electrical and radio equipment. In 1941, after taking part in the evacuation of British forces from France, he was responsible for inaugurating electrical aircraft maintenance at the Admiralty. The South Western Council is the first in the country to appoint an independent secretary. The custom has been to second a member of the corresponding Electricity Board's staff as secretary.

Mr. T. E. Laing has been appointed a director of British Resin Products, Ltd. Mr. Laing, who joined the D.C.L. group in 1943, has been works manager and more recently general manager of the joint British Resin Products, Ltd./British Geon, Ltd., factories at Barry, Glamorgan, since they were built in 1947.

At a ceremony held at Cefn Mawr, North Wales, on 21st December, 146 employees of **Monsanto Chemicals, Ltd.,** who had served for twenty-five or more years with the company received awards in recognition of that service. The presentations were made by Mr. Philip A. Singleton, managing director, in the presence of the board of directors, representatives of local authorities and nearly three hundred relatives and friends of long-service employees. The long service men were subsequently entertained to dinner by the company.

On 6th December over sixty employees of the Staffordshire factories of **Thomas Bolton & Sons, Ltd.,** were entertained to lunch by the management, and long-service awards were distributed by the general manager, Mr. W. F. Slater. There were ten certificates for over fifty years' service, forty-two for forty years' service and ten for twenty-five years' service. Nearly fifty employees have completed their half-century of work with the company during the past two years. The members of the management present at the gathering were Mr. W. F. Slater, Dr. W. E. Alkins, Mr. R. Badger, Mr. J. W. Newton, Mr. W. Cartwright, Mr. D. C. Bolton and Mr. V. B. Hysel.

Dr. M. Cook, joint managing director of the Metals Division of Imperial Chemical Industries, has been elected chairman of the British Non-Ferrous Metals Research Association as from 1st January next in succession to the **Hon. R. M. Preston,** who retires from office at the end of this year. Dr. Cook is a graduate of both Cambridge and Manchester Universities and is distinguished for his services to the metallurgical industry and profession. He is a past-president of the Institution of Metallurgists and senior vice-president and president-elect of the Institute of Metals. He is a member of Council of the Aluminium Development Association and has served over many years on a large number of industrial and Government councils and committees dealing with metallurgical matters. He has been active in the affairs of the Research Association for many years, having been a member of Council since 1940, a vice-chairman since 1951 and a member of the Finance and General Purposes Committee since 1942. He has been chairman of the Research Board since 1950.

Mr. A. S. Ladley, M.Inst.Met., has been elected chairman of the Junior Institution of Engineers for the ensuing year.

On the occasion of the retirement from the Electricity Supply Board of the Irish Republic after twenty-five years' service of **Mr. Patrick McElroy,** Letterkenny, a presentation dinner was held in Jackson's Hotel, Ballybofey, on 18th December at which his colleagues presented him with a wallet of notes and his wife a canteen of cutlery. Mr. McElroy was a well-known figure in the electrical industry even before the establishment of the E.S.B. when he designed and erected generating stations in many towns and industries throughout the country.

The staff of **Ferguson Pailin, Ltd.,** held their dinner-dance at the Grand Hotel, Manchester, on 4th December. Mr. G. A. Cheetham, managing director, responded to the toast of the company.

A British "Queen of Light" was elected and crowned in London on 20th December for the first time in two centuries. She was Miss

Mr. V. C. H. Creer, sales director, Mazda lamps and lighting, presenting a cheque to Miss Stephanie Howell, of Liverpool, on her enthronement as Britain's "Queen of Light"

Stephanie Howell, of Liverpool, who was chosen from twenty regional heat winners drawn from all over Great Britain and Northern Ireland. The competition was sponsored by the **British Thomson-Houston Co., Ltd.,** and organized by Mecca Dancing. At the Lyceum Theatre, after a pageant of characters associated with light, Miss Howell was crowned by Miss Maude Rönström, the outgoing Swedish "Queen of Light" for London. The panel of judges consisted of the Viscountess Tarbat, Lady Harwicke, Sandra Dorne, John Loder and Rudy Vallee.

The prizes (£100, £50 and £25) were presented by Mr. V. C. H. Creer, lamp and lighting sales director of B.T.H., who also gave all the contestants a compact engraved with a dancing girl (the "Mazda" trade mark).

On 17th December the **British Central Electrical Co., Ltd.,** gave its annual Christmas party to all members of the staff, who joined their chairman, Mrs. F. J. Conradi, and managing director, Mr. G. Conradi, at the Eccleston Hotel, Victoria. Dinner was followed by dancing and a cabaret. Members of the staff also gave a cabaret performance.

The annual apprentice prize-giving of **Hoover, Ltd.,** was held on 15th December at Perivale, Middlesex. Mr. W. C. Bell, a director and chief engineer, opened the proceedings, Mr. D. B. Addison (fourth year apprentice) presiding. The presentation of prizes was made by Messrs. Dobson and Young, and the works manager's shield was presented by Mr. W. J. Dimmock. Before the proceedings opened visitors were given the opportunity of seeing displays of apprentices training. The evening concluded with a one-act play, "The Bespoke Overcoat," presented by the Hoover Apprentice Association.

The London Electric Wire Co. & Smiths, Ltd., and its associated companies announce the appointment of **Mr. M. B. Bates** as manager of their Nottingham branch, in succession to **Mr. J. Atherton.** Mr. Bates has been with the company for nineteen years.

When the members of the **Ekco Foremen's Association** met recently at their annual dinner at the Overcliff Hotel, Westcliff-on-Sea, their principal guest was Mr. E. K. Cole, chairman and managing director of E. K. Cole, Ltd. Mr. S. G. Timms, chairman of the Association, presided and the guests included Mr. E. B. Willcocks, director and secretary of E. K. Cole, Ltd., and Mr. F. S. Allen, works director of the company.

Tickets are still available for the dinner-dance which is being held by the **I.E.E. Utilization Section** at the Café Royal, Regent Street, W.1, on 19th January (7 for 7.30 p.m.). Applications should be made to the Secretary, the Institution of Electrical Engineers, Savoy Place, London, W.C.2, without delay.

OBITUARY

Mr. H. Foulds.—The death occurred at Caterham on 23rd December, in his eighty-sixth year, of Mr. Howard Foulds, former secretary of Callender's Cable & Construction Co., Ltd. (now British Insulated Callender's Cables, Ltd.). The funeral took place at Caterham on Tuesday last.

Mr. F. Nicholls.—The death occurred on 21st December, at the age of sixty-eight, of Mr. Frank Nicholls, M.I.E.E., F.Inst.F., who from 1939 to vesting day was city electrical engineer and manager of the Leeds Corporation electricity undertaking. Mr. Nicholls began his career in the electricity supply industry in 1913 with the Heston and Isleworth U.D.C., joining the Birmingham Corporation Electricity Department in 1917 and proceeding to Derby in 1919 where he was successively boiler house superintendent, deputy borough electrical engineer and borough electrical engineer until his appointment to Leeds in 1939. At vesting day he was appointed manager of the No. 4 (Leeds) Sub-Area of the Yorkshire Electricity Board, which post he held until his retirement in May, 1951. Upon his retirement from the Board he became a director of the Leeds Industrial Engineering Co., Ltd. Mr. Nicholls was for a number of years a member of the Council of the I.M.E.A. and secretary of the Mid-Eastern England Centre. In 1946 he visited America and made a study of power station development in that country incorporating many of the ideas which he gathered there in the design of Skelton Grange power station, the construction of which had begun under his direction before vesting of the Leeds undertaking.

The late Mr. Frank Nicholls

Mr. Nicholls leaves a widow, two sons (both engaged in the supply industry) and one daughter.

Parliamentary News

IN the House of Commons last week Sir Alfred Bossom asked the Minister of Fuel and Power if he would give a general direction to the British Electricity Authority requiring that when a high-voltage line was carried over agricultural land a lower-voltage line should always be included, as was frequently the custom in the United States, so that any farmer or resident in the immediate neighbourhood could obtain an electricity supply without the great cost now entailed in bringing a separate line from the nearest transformer station.

Mr. Geoffrey Lloyd, Minister of Fuel and Power, said that for reasons both of economy and amenity the general practice was to take high-voltage lines the shortest distance between two points. This was not always compatible with combined construction of h.v. and l.v. lines, but such construction was always adopted when it was both practicable and economic.

Cost of Caithness Supply

Sir David Robertson asked the First Lord of the Admiralty whether he was aware that farmers and landholders at Bower Smerral, Bower Whitegar and Murza, Castletown, all in Caithness, were unable to obtain supplies of electricity from the North of Scotland Hydro-Electric Board, owing to the high cost of placing the cables underground to meet the requirements of the Admiralty; and if he would consider meeting the extra cost involved.

Mr. J. P. L. Thomas said that the North of Scotland Hydro-Electric Board applied to the Minister of Fuel and Power for his consent to the placing of electric cables above ground for supplying electricity to the areas in question. The Admiralty was obliged to object to this because of the interference to naval wireless installations in the neighbourhood. The question of whether or not a supply could be given without the use of overhead lines was for the Hydro-Electric Board to decide. In such a case as this, where the use of overhead lines would interfere with the operation of existing installations, there were no grounds for the owners of the existing installations to be called upon to make any contribution towards the additional cost of underground cable.

V.H.F. Development

In the House of Lords, Lord Ogmore asked the Government whether authority had yet been given for the extension of the B.B.C.'s v.h.f. plan to include Wenvoe.

The Postmaster-General, Earl De La Warr, said that he had now had the views of the Television Advisory Committee on the B.B.C.'s long-term plan for v.h.f. development. Adoption of the plan was recommended, with due regard to experience during its initial stages, and he had agreed with the B.B.C. that Wenvoe should be added to the first list of stations. This first stage would involve a large amount of work between now and the end of 1956, and the timetable for further developments would be settled later.

Materials for the Electrical Industry

Supply and Demand Trends in 1954

INCREASED industrial activities resulted in greater consumption of the materials used by the electrical industry during 1954. Generally speaking, prices rose at the same ti·e. as is shown in our annual review, prepared for us by the Metal Information Bureau, Ltd.

COPPER: The copper market during the past year has presented a fluctuating appearance although, on balance, quotations recorded a sharp gain over the levels prevailing when the year opened. Prophecies that copper prices would show a steady decline following the reopening of the London market for free dealings in August, 1953, proved false and 1954 witnessed record figures being paid. At one time during the year copper was changing hands at well over £300 a ton.

As the year opened consumers adopted a hand-to-mouth purchasing policy, believing that the supply position would prove adequate during the coming months; one of the chief reasons for this view was the fact that Chile (a major producer) held several thousand tons of metal which she was finding it difficult to place, coupled with a fear of a general business recession in America and elsewhere. Quiet demand for copper-containing products and the steady approach of the completion of output expansion projects in various parts of the world were other sobering factors. Sight was not lost of the fact that Chile also had a substantial running monthly output to sell. Buying interest in these circumstances focused on early delivery, with the result that prompt copper commanded a growing premium over forward (at one time this was fully £20 a ton). Early in the year producers in America began to reduce output.

Around the middle of the year the United States Government arranged to acquire 100,000 tons of Chile's big accumulation of copper for the stockpile on the basis of 30 cents per lb, delivered, equivalent to about £240 a ton. This naturally bolstered up the international market since it eliminated the shadow cast by a burdensome supply surplus.

With the cessation of operations for copper on the London Metal Exchange at the turn of the half-year by the United Kingdom Government Broker, on whom a good deal of reliance had hitherto been placed for the acquisition of spot copper, the prompt supply position hardened and undoubtedly aggravated the tight supply of electrolytic wirebars, the availability of which had been causing difficulties at some works. The question of introducing a copper contract more in line with United Kingdom consumers' actual needs was considered by metal exchange authorities on various occasions during the year but difficulties made revision impossible; however, beginning in 1955, an in-warehouse contract is being introduced as opposed to the ex-ship basis which had hitherto been used for trading on the market.

The cease-fire in Indo-China later made for easier conditions and copper supplies were more freely available at lower prices. This proved short-lived because of strikes at producing plants in Chile and the United States; these continued for some time and resulted in copper quotations on the world market reaching record figures, although American primary producers maintained their quotations at 30 cents per lb. Coupled with this was the fact that labour troubles in Northern Rhodesia—the United Kingdom's main supplier—were making for an uncertain supply outlook from that quarter. Some relief was given to consumers in America by " loans " of copper from the official stockpile.

From the fabricator's point of view, the demand for copper and copper-containing products during the latter half of the year was strong, with the result that the off-take of raw and secondary metal for 1954 will no doubt show a notable gain over the consumption figures for 1953. Comparative details are given above.

U.K. COPPER CONSUMPTION
(Tons)

Products	January-September 1953	January-September 1954
UNALLOYED COPPER:		
Wire	102,451	130,462
Rods, Bars, Sections	8,975	17,594
Sheets, Strip, Plate	30,747	43,669
Tubes	27,032	33,750
Castings and Miscellaneous	4,500	4,500
ALLOYED COPPER:		
Wire	6,141	9,141
Rods, Bars, Sections	40,872	57,834
Sheet, Strip, Plate	50,781	62,592
Tubes	9,120	9,400
Castings and Miscellaneous	28,450	36,649
Copper Sulphate	8,842	9,588
Total all products	317,911	415,179
of which: Consumption of—		
Refined Copper	224,851	314,082
Copper and Alloy Scrap (copper content)	93,060	101,097

TIN: The year opened with tin prices standing in the neighbourhood of £650 a ton. Developments in Indo-China and fears that the Far East—which provides the bulk of the world's tin—would be affected had the effect of increasing demand for the metal and quotations rose steadily during the opening months (at one time well over £800 a ton was paid): at times spot tin was commanding a premium of more than £50 a ton over forward. Demand for tin was good in face of the tight supply position, at any rate during the early months of the year. By May an improved spot supply resulted in cash and forward quotations coming into closer alignment.

One of the main developments in tin during 1954 was the steady move towards implementation of an international scheme to regulate production and exports and stabilize prices through the operation of a buffer stock. The plan did not find favour in America, the world's main tin consumer, but nevertheless went through, ratification being expected to be complete early in 1955. The tin market has been influenced by the proposals, particularly during the latter part of the year. The fact that the United States, whilst not a party, had not been antagonistic, had agreed not to unload stockpile holdings and had concluded contracts with Indonesia and Belgium, provided a bolstering effect on prices.

United Kingdom tin output averaged around 2,250 tons a month, with consumption slightly less.

LEAD: For lead the year opened quietly with the undertone of the market easy—the price of nearby lead was quoted at around £89 a ton, forward metal being available at a discount of about 30s a ton. The uncertain outlook was engendered mainly by weakness in the American market, as a result of which some fair quantities of Mexican and South American lead were being offered in London. During the early months there was growing agitation in the United States for an increase in import duties in order to alleviate the effects of foreign shipments on the domestic market.

Demand in Britain was no better than moderate and consumers, fearing price falls, went in for hand-to-mouth buying, which caused prompt metal to become tight in supply and gradually firm in price. By May developments in Indo-China had given the market a firmer undertone and this, coupled with the later re-entry of the American Government as a stockpile buyer, bolstered the market further. Broadening demand found imports into Great Britain barely sufficient to cover requirements whilst the subsequent dock strikes in this country and Australia further aggravated a growing tightness in the supply position. At one time United Kingdom quotations rose to more than £112 a ton; by the year end they were lower but still in excess of £100 a ton.

United Kingdom consumption of lead, by trades, during the first nine months of the year was as follows:—

U.K. LEAD CONSUMPTION
(Tons)

Trades	January-September	
	1953	1954
Cable making	69,002	61,537
Battery (excl. oxides)	20,724	22,522
Oxides and compounds:		
Battery	16,858	20,586
Other uses	21,791	30,914
White lead	8,155	8,770
Sheet and pipe	51,995	58,691
Shot	3,329	3,776
Foil and collapsible tubes	2,288	2,863
Solder	7,513	9,182
All other alloys	8,474	10,975
Misc. uses	11,770	16,550
Total consumption	221,799	246,366
of which:		
Imported virgin lead	111,261	142,559
English refined	49,240	47,696
Scrap and remelted	61,298	56,111

ZINC: The zinc market presented a reasonably stable appearance during 1954 with London Metal Exchange quotations for nearby metal fluctuating over the period as a whole between about £72 and £82 a ton; at no time were there violent price movements. Demand for zinc in Great Britain was good, particularly during the second half of the year, and undoubtedly total absorption in this country during the whole of 1954 will show a substantial gain over the preceding year's figures. Most sections of the zinc consuming industry can be said to have been active, with the galvanizers, brass makers, die-casters, rollers and oxide makers accounting for the bulk of the use.

Although the year opened quietly there was a noticeable resistance to permitting the price of good ordinary zinc of minimum 98 per cent, on which quotations of the London Metal Exchange are based, to fall below £70 a ton—and this remained a feature of the market throughout 1954. There was, in general, a sustained demand for scrap. By the middle of the year the spot supply position had improved sufficiently to enable nearby zinc to be quoted at a small discount from forward, thus enabling the L.M.E. to be more fully used as a hedging medium.

The improved supply resulted from offerings from time to time of Mexican and South American metal—and occasionally Russian—which sellers were loath to force on the American market. The top-heavy statistical position in America resulted from sustained output in the face of an already overstocked industry; various efforts were made to get the import duty on zinc increased but, despite U.S. Tariff Commission recommendations, President Eisenhower refused to agree, instituting instead a long-term stockpile purchasing programme. Under this, monthly tonnages of zinc are normally taken from domestic sellers, thus aiding the pricing undertone of the zinc market in general. The end of the year saw the international zinc market fairly well balanced.

RUBBER: With the 1953 world output of natural rubber at 1,725,000 tons compared with a consumption figure of 1,615,000 tons, 1954 opened with a surplus of about 100,000 tons. The fear of a general recession in business in America and elsewhere during the early months coupled with a reduction in stockpile buying cast a shadow over the rubber market and prices at the beginning of 1954 were weak at around 1s 4d per lb, in London. When the slump seemed less likely American consumption increased and, with confidence returning, prices began to harden.

An International Rubber Study Group estimate about mid-year indicated only a small surplus of rubber which, aided by a good and growing demand from Western Germany, France, Italy and the United Kingdom, coupled with consumers being not over-covered, resulted in quotations gaining further. About July-August strikes in the United States resulted in rubber prices steadying at around 1s 8d per lb, but renewed demand later pushed values up to 2s to 2s 1d per lb.

In general, it can be said that there was a move from synthetic to natural rubber in America during 1954; with the outlook by the year-end strong, and with a good statistical position, there may be some further price rises. In the normal way the first quarter tends to be characterized by reduced output and increased consumption. No international agreements were concluded during 1954.

ALUMINIUM: In comparison with 1953 the past twelve months have witnessed more active conditions in the aluminium industry in this country. Whilst it cannot be said that boom conditions now prevail, there is no doubt that since about the middle of 1954 the producers of semi-manufactured items have found themselves increasingly engaged, with the result that in some of the more popular items there are again some delivery delays.

With home output of virgin aluminium totalling only 31,000–32,000 tons a year, it is apparent that substantial quantities must be brought in from abroad; the arrangements made with the big Canadian producer have worked satisfactorily and throughout the year consumers were able to obtain raw metal supplies based on a price of £156 a ton, delivered, for 99½ per cent purity. As prices of other metals, notably copper, have recorded sharp gains during 1954, the light metals have been given an opportunity to regain lost ground.

In general, much expansion has been noted, particularly in the United States and Canada, which would seem to indicate a belief that industrial and military requirements of aluminium and its alloys over the coming years will be maintained. It certainly looks, at the moment, as though there will be a continued call for aluminium in 1955 from a variety of consuming industries.

IRON AND STEEL: There has been growing activity in almost every branch of the British iron and steel industry. The year 1953 ended with a new steel output record and the industry entered the new year with comparative

optimism, but certain sectors, notably the re-rolling mills producing small bars and light sections, were not fully employed, and orders for heavy joists and sections showed some signs of falling off. The great clamour over the plate shortage was dying down, the urgent needs of the shipyards having been met by increased output and higher imports. Sheet makers were under heavy pressure, which has been their normal condition almost uninterruptedly since the end of the war. Broadly speaking home demand for steel was strong, the export market was fairly favourable, and the industry expected a busy year with the possibility of rather quieter conditions towards its end. The huge imports of 1953 were beginning to decline, although important tonnages of pig iron were still needed until new British blast furnaces were ready.

As it happened, however, the steel industry has been somewhat surprised by a great and growing demand, which by the end of the year has resulted in the scarcity of a number of products (including wire rods, strip, sheets and heavy sections), a recovery in imports (especially of sheets), and a good flow of exports with rising prices. Thus the industry enters 1955 with congested order books and faced with a strong and insistent demand.

Imports of sheets are expected to total at least 150,000 tons compared with a mere fraction of this in 1953. Most of the tremendous demand for sheet steel comes from the motor car industry which is working at top pressure and carrying out expansion plans. When these plans mature they will call for additional supplies of sheet steel, and the industry will be hard put to it to supply them. Even with the increased sheet output expected in 1955 imports will have to be made, and may well exceed the tonnage brought in in 1954.

After falling in the early part of the year British steel export prices have now begun to firm up. In the home market the Iron and Steel Board has carried out a review of prices and price structure and broadly speaking prices have been increased by about 3 per cent in 1954.

It is confidently expected that the steel industry will have produced 18·5 million tons of raw steel in the past year; in 1955 it is expected that output will rise by 0·75 million tons to 19·25 million tons.

Water Power in New Zealand

THE demand for power throughout both islands of New Zealand is ever increasing. After the Taupo–Waikato River scheme and others in the North Island and Roxburgh in the South Island, Benmore is scheduled to be the next major undertaking. It will be the largest in the Dominion, with a capacity of 340 MW, compared with the 320 MW at Roxburgh. These figures show the tremendous potential of the South Island rivers in hydro-electric development. The Clutha can be harnessed several times to produce as much power as that expected from Roxburgh, or more, but it is rivalled by the Waitaki which, although by no means so impressive a river, now produces a substantial proportion of the power fed into the South Island grid system.

Under the name of Black Jack's Point, the Benmore scheme was first mentioned as a serious project soon after it was decided to go ahead with work at Roxburgh Gorge. During the recent session of Parliament, the Minister of Works, Mr. W. S. Goosman, made the first official announcement that Benmore would be the next major South Island scheme.

Waitaki power station, New Zealand, which has just reached its maximum development

Like the Clutha, which is fed by Lakes Wakatipu, Wanaka and Hawea, the Waitaki River draws its water from three major lakes, Tekapo, Pukaki and Ohau. Between them, they can provide enormous storage of water for the winter months when the electricity demand reaches its peak. The lakes feeding the Waitaki have the great advantage that they can all be controlled and built up to high levels with reserve water, whereas any raising of the levels of Lakes Wakatipu and Wanaka would threaten the populous tourist townships on their shores.

Although the Clutha probably has a substantially bigger flow than the Waitaki, only Lake Hawea is ever likely to be controlled to provide water storage and so power schemes on the Clutha will depend largely on the natural flow of the river. The Waitaki power scheme at Kurow, about 40 miles from the sea, was started 25 years ago and began producing power in 1935. It reached its maximum development this year, nearly 20 years later when two generators, bringing its capacity up to 105 MW, were brought into service. There will be no similar respite for leisurely development in the future. Although Roxburgh Gorge will double the output of South Island stations, its full development will be needed within 10 to 12 years—possibly less.

At Benmore, the Waitaki River flows through a deep gorge and takes an " S " bend near the probable site of the power house. Construction will therefore be simplified by the opportunity to construct a diversion channel and erect the dam over it as at Roxburgh Gorge. Because of the depth of the gorge, Benmore will have a capacity three times that of the present station, in spite of the fact that the site is just above the junction of the Ahuriri River, which benefits the Waitaki station. Since lake control has already been established at Tekapo and Pukaki to provide winter storage for the Waitaki station, Benmore will have the benefit of these works without additional capital cost. It is understood, however, that the Hydro-Electric Department engineers contemplate control being established on Lake Ohau to assist in the storage of water for the winter. The experience of the present season has shown how important it is to build up the lakes in the summer so that an adequate flow of water can be provided during the winter and spring. Last autumn Lakes Tekapo and Pukaki were at maximum level and the threat of further rain made it necessary to release large quantities of water, which put the Waitaki River into high flood and caused some erosion in the lower reaches. Then followed an unusually dry winter and severe power economies were necessary.

INDUSTRIAL NEWS

Power Farming Conference

The National Power Farming Conference will be held at the Royal Hall, Harrogate, from 15th to 17th February. The papers will be centred on the theme of mechanical handling, and will cover not only soils and cropping, but essential points in livestock husbandry. The Conference chairman will be Mr. J. T. Beresford. There will be no charge for attendance, but admission will be by ticket. Inquiries should be addressed to the Conference Organizer, *Power Farmer*, Dorset House, Stamford Street, London, S.E.1.

B.E.P.C. Exhibition Marquee

Although there was an objection by the chairman of the Car Parking Committee, the Brighton Town Council recently decided to permit the erection of a marquee on the car park adjoining the Sports Stadium, West Street, Brighton, for the exhibition to be held in conjunction with the British Electrical Power Convention next June.

Scientific Workers' Wages Claim

The Association of Scientific Workers has applied to the Engineering Employers' Federation for a substantial increase in the salaries of scientific and technical staffs employed in the industry. It is expected that a meeting with the employers will take place shortly to discuss this claim.

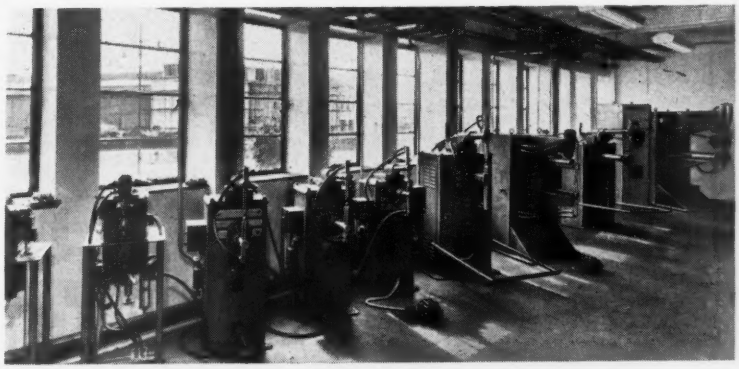
Television Society Exhibition

The annual exhibition of the Television Society will be held from 6th to 8th January at University College, Gower Street, London, W.C. Tickets, which are free, can be obtained from the secretary of the Society, 164, Shaftesbury Avenue, London, W.C.2.

Motor Control Gear Exhibition

Arrow Electric Switches, Ltd., completed its 1954 programme of private exhibitions of motor control gear by holding a show recently at the Midland Hotel, Manchester. The attractive library where the exhibition was staged, proved to be an ideal setting. This year the company has held private exhibitions at Birmingham, Glasgow, Bradford as well as Manchester and all these shows have been well attended by design engineers and purchasing officers.

An exhibition of motor control gear held by Arrow Electric Switches, Ltd., in Manchester



Part of the resistance welding demonstration room of Siemens-Schuckert (Great Britain), Ltd.

Welding Demonstration Room

Faced with the need for high output, production engineers in many industries are turning to resistance welding to provide an answer to their problems. Many engineers prefer to see the assembly welded before completing their manufacturing procedure. In order to do this without interfering with normal production of machines, Siemens-Schuckert (Great Britain), Ltd., has a fully equipped special resistance welding demonstration room at its factory on the Great West Road. It occupies a space of 62ft by 21ft and is equipped with a large number of different sizes and types of machines. These cover the whole range from the spot welding of the finest gauge of wire, such as is used for small valve filaments, to the seam welding of large pressure tight drums. Pedal operated and air operated machines are installed; the two methods of current control of seam welders, by modulator and by ignitron panels, are catered for.

The machines are ranged along one side of the room in order of size, and the power, water and compressed air supplies have been arranged so as not to interfere with the demonstration of welding by any particular machine. The features of each machine can be fully examined. The visitor can see the welding of his own or typical samples carried out on various machines successively, and can compare results in order to determine the choice of the most suitable size of machine, in relation to his particular output requirements. The demonstration room also contains a variety of the other products of the company, and includes a number of electric furnaces for heat treatment, up to 1,400 deg C, and a l.v. distribution switchboard which controls a number of the machines in the room. While this board is no larger than the conventional switch-fuse distribution board, each circuit is equipped with an automatic circuit breaker with current balance earth leakage protection. At one end of the demonstration room and separated from it by a partition, is a small workroom where work incidental to the welding of samples, and the preparation of prototype parts, can be carried out.

Railway Freight Charges

The British Transport Commission has completed a draft of the Railway Freight Maximum Charges Scheme, as required by the Transport Act, 1953, and is now engaged in a series of consultations with important bodies of transport users upon the substance of this draft. Thereafter the final draft Scheme will be submitted to the Transport Tribunal for a full public inquiry at which all bodies representative of railway users and other interested parties are entitled to be heard.

Under the terms of the 1953 Act, any Charges Scheme submitted to the Tribunal must confine itself solely to establishing maximum charges. In this it differs fundamentally from the old schemes, which purported to fix standard charges. Thus the new Scheme will not settle the actual charges which will normally be paid. These will be a matter for competitive quotation beneath the maxima, and for commercial negotiation between the parties concerned. Failing agreement upon any particular traffic the consignor may, provided that other means of transport cannot be used, appeal to the Tribunal to fix an actual rate.

Schoolboys' Exhibition

A "flying saucer" that has crash landed in the New Horticultural Hall, Westminster, will be a feature of the Schoolboys' Own Exhibition which opens to-day (Friday). Much of the equipment of this 50ft diameter ship has been "salvaged" by the British Electrical Development Association, and is demonstrated. A range of "Hence Viewers" gives a foretaste of things to come and the "I/Q switch" selects candidates for the "Quiz Deck" where visitors can test their knowledge of good and bad practice in electrical applications in the present-day home. The key factor here is "service and safety" for the all-electric home of the present and future.

Young visitors to the electronic saucer will be presented with a coloured broadsheet containing stories of heroes of invention, the adventures (in strip cartoon form) of a cosmic scientist of to-morrow, descriptions of Britain's atomic power plants, an outline of fascinating careers for the electrically minded and, finally, a competition for prizes of £5, £3 and £1. A visit to the E.D.A. exhibit must impress the boys that they are on the verge of the Atomic Age, that its benefits will come to them very largely in the form of electricity, and that it is necessary that they should know all about the uses of electricity, particularly in the home.

New G.E.C. Leeds Premises

On 14th December the chairman of the Yorkshire Electricity Board, Mr. D. Bellamy, opened the reconstructed premises of the General Electric Co., Ltd., in Wellington Street, Leeds. The opening ceremony was attended by Mr. Leslie Gamage, vice-chairman and joint managing director, and many friends of the G.E.C. in the area. After the ceremony visitors were taken round an exhibition designed to illustrate as much as possible of the wide range of the company's activities. The first G.E.C. branch in Leeds was opened in 1911 at Wellington Street, and the number of the staff has grown from twelve to eighty-four. The present manager is Mr. F. Smith. Two years ago further extensions and modifications were on the point of completion when a fire destroyed the interior of the original premises. These have now been reconstructed to accommodate new offices, stores and showrooms.

The ground floor of the new building houses a spacious entrance hall, the trade counter, and the offices of specialist departments. Fluorescent lighting has been adopted throughout the offices, which are made still lighter by the use of cross-reeded glass wall panels. The showrooms on the first floor comprise one of the most comprehensive displays in Yorkshire of electrical equipment for the home. One section is fitted out to make possible trade demonstrations of cookers, refrigerators and other domestic equipment, while the remainder is devoted to the display of contemporary and period lighting fittings, television and radio receivers. The main contractors were Kenyon & Co., Ltd., the steelworks sub-contractors Dunlop & Ranken, Ltd., and the electrical contractors Wallis & Watson. The reinforced concrete floors were installed by Concrete, Ltd.

Electricity on the Farm

When the Merseyside and North Wales Electricity Board was first constituted in 1948, one of the biggest problems which faced it was the provision of electricity to large tracts of rural areas which had no supply. That work is now well under way, and last year (ended 31st March, 1954) a total of 1,426 new farm connections were made—in addition to other types of premises in rural areas. With so many farms experiencing the benefits of electricity for the first time, another problem has arisen, that of having suitably trained staff who can assist and advise agricultural consumers to obtain the most efficient and economical usage of the electricity at their disposal. A new departure in staff training is being introduced next month, when the Board will hold a five-day course on farming at the Caernarvonshire County Farm Institute, Glynllifon (near Caernarvon). This will be attended by twenty members of the Board's commercial staff, who normally work in agricultural localities, and will include both theoretical and practical training.

Latin American Trade

Within five years, Britain could quadruple her exports of capital goods to Latin America. This is the principal conclusion drawn by Mr. J. P. Ford, chairman of the Institute of Export, and managing director of Associated British Oil Engines (Export), Ltd., Brush Export, Ltd., and National Oil Engines (Export), Ltd., the three companies responsible for the export sales of the Brush Group, Ltd., after a 30,000-mile tour, during which he met senior ministers, state banking officials and industrialists in thirteen Latin American countries. Speaking at a Press conference last week he said that the potential development in these countries was incalculable, and British manufacturers must take advantage of this situation now. British deliveries which had been showing an improvement were now falling off again. If we did not watch our step, we should not achieve this potential export "target" of £400 million within the next five years.

General view of the new showrooms at the Leeds branch of the G.E.C.

Plant for Bloemfontein

The British General Electric Co. (Proprietary), Ltd., South Africa, has received a contract from the Municipality of Bloemfontein for a further 10 MW turbo-generating set complete with ancillary apparatus. This machine forms part of the extensions to the No. 2 power station. Two similar machines ordered previously are in course of erection. The consultants to the municipality are Merz and McLellan (South Africa).

South African Tariff Application

An application has been made to the South African Board of Trade and Industries for a substantial increase in the duties on miniature electric circuit breakers. United Kingdom firms affected by this can obtain information and advice from the Commercial Relations and Export Department, Board of Trade, Horseguards Avenue, London, S.W.1 (Ref. C.R.E. 13778/54).

Iraqi Electrical Imports

Imports of electrical machinery into Iraq totalled 1,826,000 dinars in value in the first half of 1954, compared with 1,624,000 dinars in the corresponding period of last year. (Iraqi dinar=£1).

Calendars

Davidson & Co., Ltd., have sent us a calendar with large monthly sheets, showing also the preceding and following months, above which is a picture in colour depicting a rural scene.

The calendar of the Danfos Manufacturing Co., Nordborg, Denmark, has large monthly sheets, each of which has a coloured illustration of a section of the company's works.

"Spring in the Highlands" makes a colourful picture for the calendar of F. V. Williams & Co., which has monthly slips.

The calendar of Panelec (Great Britain), Ltd., has two months on each sheet and illustrates various types of buildings in which the company's low temperature radiant floor and wall system has been installed.

Trade Announcements

James Booth & Co., Ltd., have opened a new sales office at Exchange Buildings, Quayside, Newcastle-upon-Tyne, 1 (Branch manager: Mr. C. C. Barber). Telephone: Newcastle 29731.

On 1st January the company is opening a sales office at 93, Hope Street, Glasgow, C.2 (Branch manager: Mr. C. G. Skidmore). Telephone: Glasgow Central 2715.

The London office of **Porter Electrical Products, Ltd.,** is now at 17, Crawford Street, W.1 (telephone: Hunter 0515).

Halsey's Electric Co., Ltd., has transferred its main stores to Brandon House, Wyfold Road, Fulham, S.W.6.

OVERSEAS ELECTRICAL TRADE

Exports Seriously Affected by Dock Strike

THE dock strike, which had a comparatively small effect on exports of electrical machinery and apparatus in the official returns for October, resulted in a very marked decline in shipments last month. At £10,882,293 the November total was £1,748,185 below the previous month's figure and no less than £4,937,365 lower than that of the corresponding month of 1953. Actually the result is somewhat worse than it appears since November, 1953, contained five Sundays.

Up to last month the cumulative total for the year so far has kept slightly ahead of that for the corresponding months of 1953, but with the latest figures the total for the first eleven months of the year at £157,502,343 lags £4,574,824 behind the January–November, 1953, total.

Full particulars of the values of exports of individual products appear in Table I, with an analysis of destinations in Table II. As the various docks were not all or equally affected by the strike the distribution of products to the different markets did not always follow the same pattern as usual. It cannot be this cause alone which placed Canada at the head of the list of purchasers of generators and motors since its share of the total of £1,819,163 worth exported last month amounted to £439,892 compared with an average of £113,226 for the previous ten months: the next largest buyers of this class of equipment were Australia (£252,989), South Africa (£127,690) and New Zealand (£111,722). Taking £243,726 out of a total of £1,771,587, Canada was also easily the best market for valves and radio, television, etc. equipment and was second (with £214,577) among the buyers of converting equipment, only South Africa (£301,625) taking more.

South Africa was again the best market for telegraph and telephone equipment, its share (£205,645) of the £923,065 total being well over double that of the next best customer, Australia (£82,122). India (£122,769) and New Zealand (£113,151) took the largest shares of the cables and wires exported.

In addition to the items covered in our tables, there are many other electrical products classified separately in the official return. Among these are washing machines, not exceeding 150 lb weight, of which £218,733 worth were exported in November, making £2,709,508 (£2,576,508) for the first eleven months of the year; ditto, over 150 lb weight, £123,744 making £1,423,847 (£1,045,196); washing machine

TABLE I.—ELECTRICAL EXPORTS

Class	Nov., 1954	Eleven months ended 30th Nov.	
		1953	1954
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW...	90,216	983,204	1,095,000
Ditto, 10 to 65 kW	86,905	1,534,065	1,621,608
Ditto, 65 to 200 kW...	53,059	1,012,682	856,383
Ditto, over 200 kW...	133,083	1,748,578	3,480,138
Spark ignition engine driven	11,938	297,850	176,910
Steam turbine driven	199,000	1,744,695	1,009,921
Other prime mover driven...	28,641	477,199	1,026,587
Generators	71,331	2,645,078	2,066,380
Parts of generators	365,225	5,093,744	4,554,249
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ¼ h.p.	210,530	1,456,583	1,978,556
Over ¼ h.p. but under 1 h.p.	59,604	379,675	568,355
1 h.p. to 250 h.p.	260,228	4,323,579	4,089,739
Over 250 h.p.	36,946	837,128	1,294,800
Railway, tramway and trolley-bus motors complete and parts of all motors	100,708	1,892,472	1,433,746
Motor starting and controlling gear	111,749	2,564,177	2,010,829
Converting machinery	10,342	419,049	303,896
Mercury-arc rectifiers	36,352	630,983	536,107
Transformers for lighting, heating and power (incl. coils)	566,005	11,153,974	9,889,184
Switchgear and switchboards (not telegraph or telephone)	932,702	14,717,769	13,790,363
Primary batteries:			
Lighting	52,809	649,542	714,478
Radio	125,058	961,928	1,592,874
Other	34,610	473,635	479,092
Parts (excl. carbons)...	35,556	278,581	544,969
Lamps:			
Filament, exceeding 24 V	62,233	741,000	815,880
Ditto, under 24 V	23,296	238,545	325,750
Discharge lamps, fluorescent tubes, etc.	40,740	475,633	623,700
Other lamps	13,623	149,724	237,510
Radio and television, etc., apparatus:			
Cathode-ray tubes	11,360	147,590	122,729
Other valves (not X-ray)	123,500	1,867,079	1,743,692
Radio and television transmitters	7,160	858,161	602,239
Commercial radio and radar equipment	753,788	9,008,527	10,899,463
Domestic radio receivers, mains	112,642	2,140,359	1,700,070
Ditto, battery	34,292	494,896	561,767
Ditto, other (incl. car)	9,804	148,580	140,848
Radiograms	22,460	441,018	386,613
Television sets	85,785	405,640	423,078
Public address equipment	53,789	530,002	644,800
Sound reproducing app., n.e.s.	17,601	168,055	247,539
Components and parts, n.e.s., incl. parts of valves and c.r. tubes	539,406	4,814,282	6,048,223
Telegraph and telephone installations	475,149	4,687,077	6,114,227
Telephone instruments, separately consigned	49,746	1,647,286	1,087,345
Telegraph and telephone parts	329,263	6,822,066	4,847,239
Line apparatus for long distance commun.	68,907	2,024,481	1,401,350
Cookers	94,937	497,593	887,758
Toasters	23,191	195,808	224,609
Other cooking apparatus	21,832	223,809	365,721
Parts and accessories	40,411	320,174	489,202
Space heating appliances	39,148	213,508	367,334
Water heating appliances	18,345	271,854	262,820
Other heating appliances	17,224	266,086	333,268
Parts and accessories	55,062	474,579	538,252
Irons	103,251	590,473	701,287
Arc welding equipment, a.c.	24,731	477,273	353,472
Ditto, d.c.	34,624	426,837	479,828
Resistance welding equipment	10,947	114,363	170,329
Magnetos, ignition	6,240	214,875	148,762
Sparking plugs...	106,371	1,287,784	1,533,071
Elec. appliances for aeroplanes, n.e.s.	108,224	1,785,607	1,900,184
Ditto, for motor vehicles, n.e.s.	200,804	1,936,676	2,383,925
Ditto, for cycles, n.e.s.	44,821	722,973	800,545
Signalling app. (incl. traffic signals)	38,033	708,488	544,620
Industrial radio-frequency equipment	12,996	154,224	230,746
Bell app. (not telegraphic or telephonic)	6,199	83,378	88,626
Instruments, commercial	115,430	1,584,956	1,581,512
House service meters (not prepayment)	51,921	898,722	1,206,520
Ditto, prepayment, and parts of all house service meters	8,474	104,674	153,407
Electro-medical apparatus (not X-ray)	45,878	435,534	482,085
X-ray apparatus (excl. tubes and valves)	27,240	652,946	506,624
Vacuum tubes	13,022	222,600	192,771
Desk fans	14,998	323,047	338,500
Ceiling fans	34,294	1,014,792	942,977
Vacuum cleaners	139,211	1,346,481	1,827,513
Floor polishers	65,194	652,543	1,065,544
Food mixers	72,053	476,259	558,054
Hair clippers and dry shavers	173,394	482,124	1,115,651
Other portable appliances	24,452	188,198	299,454
Parts	75,110	469,215	798,373
Portable elec. tools (not saws) and parts	137,695	1,547,503	1,706,034
Cables and wires:			
Telegraph and telephone, submarine	73,534	879,766	731,761
Ditto, other	221,336	7,361,045	3,377,679
Cotton, silk or art. silk insulated	26,856	617,564	387,902
Enamel, glass or asbestos insulated	45,263	908,720	755,743
Paper insulated	311,251	10,145,390	5,408,121
Rubber insulated	258,708	4,590,215	4,158,907
Other	212,614	2,938,047	2,480,701
Accumulators for motor vehicles	73,387	1,581,771	1,601,349
Ditto, traction...	12,268	193,649	254,202
Ditto, radio and other portable	42,825	470,217	445,016
Ditto, other	47,456	540,715	567,798
Parts and accessories	49,614	530,416	648,882
Elec. porcelain, etc. (incl. insulators)	48,938	869,988	866,322
Insulating cloth and tape	47,605	498,518	541,760
Other insulating material	81,080	687,853	809,250
Permanent magnets	56,466	357,067	448,657
Radio, telegraph and telephone testing equipment, n.e.s.	40,678	787,343	357,466
Scientific elec. instruments (not telegraphic or telephonic)	182,594	1,614,743	2,290,938
Electrical machinery, n.e.s.	118,546	846,411	1,418,684
Electrical apparatus and appliances, n.e.s.	478,376	6,130,778	5,508,697
TOTAL	10,882,293	157,502,343	152,927,519

TABLE II.—DISTRIBUTION OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	Nov., 1954	Eleven months ended 30th Nov.	
		1953	1954
	£	£	£
Channel Islands	46,588	441,331	602,852
Gibraltar	87,778	171,804	178,644
Malta and Gozo	16,711	291,052	489,232
Cyprus	84,726	550,968	670,500
Sierra Leone	13,580	330,266	246,470
Gold Coast	70,964	1,100,075	1,155,697
Nigeria	86,635	2,075,982	1,612,667
Union of South Africa	1,006,813	18,207,491	16,211,460
Northern Rhodesia	83,387	1,286,604	1,270,778
Southern Rhodesia	107,376	2,347,883	2,116,732
Tanganyika	14,257	569,549	578,828
Kenya	146,461	2,530,995	1,572,073
Uganda	38,094	799,514	629,273
Nyasaland	6,198	130,931	99,829
Mauritius	7,611	261,058	199,088
Aden	34,882	1,630,438	790,003
Bahrain, Qatar and Trucial Oman	65,633	990,815	1,163,552
Kuwait	87,325	1,560,978	1,217,541
India	627,966	16,688,978	13,542,597
Pakistan	71,929	2,632,851	4,452,379
Singapore	259,114	2,710,627	2,883,514
Federation of Malaya	151,152	2,718,223	2,295,417
Ceylon	84,719	1,692,958	1,223,214
British North Borneo	12,854	330,882	376,294
Hong Kong	86,187	1,924,002	1,596,643
Australia	1,052,054	15,702,407	15,576,310
New Zealand	586,236	8,762,440	8,804,400
Canada	1,170,129	8,085,973	7,464,064
Jamaica	86,507	664,810	673,863
Barbados	11,386	137,174	206,478
Trinidad	44,989	784,323	823,465
British Guiana	18,711	315,478	351,479
Anglo-Egyptian Sudan	4,309	1,070,625	942,475
Other Commonwealth countries	54,700	1,386,064	1,228,455
Irish Republic	269,229	3,069,427	2,962,866
Soviet Union	11,815	954,220	1,911,404
Finland	65,614	730,245	1,190,687
Sweden	335,551	3,702,167	3,806,288
Norway	210,213	2,760,121	2,861,431
Iceland	16,501	199,790	176,130
Denmark	151,967	1,191,196	1,777,448
Poland	21,951	981,549	573,174
Western Germany	189,542	864,307	1,392,723
Netherlands	649,726	4,622,443	5,815,833
Belgium	267,078	3,252,931	2,754,131
France	165,918	2,647,339	2,898,269
Switzerland	72,653	780,122	939,265
Portugal	82,579	1,517,943	1,912,557
Spain	251,270	2,684,145	2,630,981
Italy	233,548	2,140,070	2,441,311
Austria	33,277	592,465	582,069
Czechoslovakia	1,228	59,838	31,500
Yugoslavia	11,417	541,715	989,476
Greece	81,431	849,443	788,809
Roumania	12,435	1,075,841	27,378
Turkey	44,115	1,024,047	533,906
Netherlands Antilles	3,632	138,639	70,241
Belgian Congo	13,261	357,013	283,787
French Morocco	20,732	255,959	250,734
Angola	9,286	126,790	111,261
Portuguese East Africa	1,339	228,027	220,593
Syria	21,022	252,174	280,167
Lebanon	11,515	368,636	328,401
Israel	15,367	638,619	319,007
Jordan	5,984	275,901	198,994
Egypt	76,832	1,161,933	1,007,023
Libya	6,119	198,680	89,647
Saudi Arabia	23,708	443,271	533,222
Iraq	79,465	2,171,205	2,282,992
Iran	19,157	199,182	353,256
Burma	170,403	1,184,531	1,484,665
Thailand	61,488	1,381,917	1,679,081
Indonesia	124	746,588	430,622
Japan	26,808	716,463	681,201
United States of America	161,117	2,164,399	2,443,729
Cuba	13,927	186,860	184,255
Mexico	30,924	324,780	326,918
Colombia	88,249	550,264	991,020
Venezuela	241,389	1,655,233	1,788,944
Peru	12,147	399,286	313,848
Chile	26,116	405,573	327,479
Brazil	14,079	1,131,641	653,875
Uruguay	8,928	327,948	694,959
Argentine Republic	88,145	844,869	834,461
Other foreign countries	124,011	1,539,049	1,519,235
TOTAL	10,882,293	157,502,343	152,927,915

parts £34,080, making £542,479 (£387,832); electric conduit tubes and cased tubes £52,201, making £726,999 (£836,489); welding electrodes, ferrous £55,814, making £737,188 (£879,434); ditto, non-ferrous £21,480, making £243,548 (£352,011); and electric locomotives £159,831, making £1,819,748 (£3,791,949).

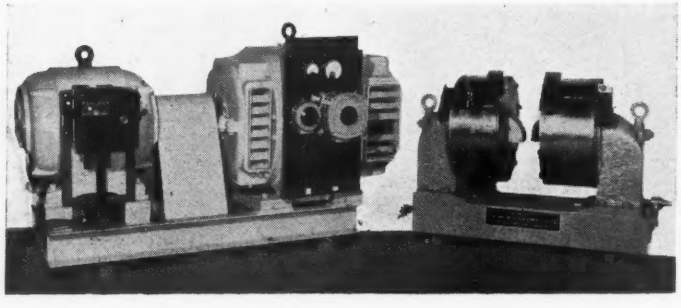
Imports of electrical machinery and apparatus in November were valued at £1,567,974 and included communication equipment (£483,977), valves (£175,561), generators (£127,000) and cathode ray tubes (£86,949). Holland was still the biggest supplier (£396,863) but Western Germany (£259,685) ousted the United States (£204,034) from the position of being the second largest source of supply. For the first eleven months of the year the total electrical imports were valued at £14,589,062, compared with £8,830,901 for the corresponding period of 1953.

Laboratory Magnet for Atomic Research

THE laboratory magnet illustrated has been made by the Magnetic Equipment Co., Ltd., for the Atomic Energy Authority to use in fundamental research and will be employed on susceptibility measurements under all temperature conditions. The air gap is adjustable and is capable of taking Dewar flasks as well as a miniature furnace.

The magnet poles are about 100 sq cm each and the curve employed is that due to N. Davey (*Philosophical Magazine*, Vol. 33, 1942, p. 575). The air gap is three dimensional and the accuracy in each direction is within 0·001in over the full adjustment of the gap.

Power for the unit is provided by a motor generator set driven by a 30 h.p. three-phase motor, separate control being provided for automatic voltage regulation, etc. Due to the high power input to the magnet and the necessity for obtaining a high constancy of field strength, which would be jeopardized by increases in air gap dimensions set up by temperature variation, forced air cooling is provided for the coils which are wound so that every turn is cooled. The mounting on which the coils are wound, and which is supported on the taper pole cores, is also water cooled. The total weight of the equipment is over 3½ tons.



Laboratory magnet and power supply unit for the Atomic Energy Authority

Protective Tariff Applications

How United Kingdom Exporters Can Contest Them

By JOHN C. HANCOCK

THE many applications for increased tariff protection now being submitted by electrical manufacturers in the Dominions constitute a serious threat to United Kingdom exports. The most recent application, reported a week or two ago in the *Electrical Review*, concerns a wide range of electric motors, from 1 to 1,500 h.p., as well as parts imported for local assembly. A duty of 25 per cent *ad valorem* under the British preferential tariff is proposed (at present electric motors of United Kingdom manufacture enter duty free) with an increase in the duty under the intermediate tariff from 5 to 30 per cent. Under the General Agreement on Tariffs and Trade (G.A.T.T.) " no new preference " rule the 5 per cent differential between the British preferential rate and the intermediate rate cannot be widened.

Previous applications submitted by South African manufacturers have included electric cables, both power and telephone, certain heat switches and power transformers. Indian, Australian and New Zealand manufacturers have also submitted tariff applications covering an equally wide variety of electrical goods.

Although some applications may be rejected, by far the larger proportion are granted, though not necessarily to the full extent of the protection requested. However remote the prospect may appear of staving off any increase, British manufacturers should endeavour to contest every application. Often a well-reasoned case will prevent an increase being granted or may carry enough weight to keep the increase down to a reasonably low level.

Submission of Representations

Under the Ottawa Agreements Act, 1932, manufacturers and other interested parties in any of the Dominions and the United Kingdom are entitled to submit representations whenever a tariff application is referred to the appropriate body for inquiry and report. Notices are usually promulgated locally in the official gazettes of the countries concerned and repeated in the United Kingdom's *Board of Trade Journal*.

While it may be true in some instances to say that a combined case, presented by a group of manufacturers or a trade association in opposition to the requested increase, is likely to be more effective than a number of cases submitted by individual manufacturers, this need not deter any manufacturer from submitting his own representations if he wishes.

Since any parties with a direct interest in the outcome of a tariff inquiry are entitled to submit evidence, importing and consumer interests in the countries concerned should, if possible, be stimulated into action. A strong lead can often be given from the United Kingdom if principals instruct their oversea representatives to enlist the support of local users.

Each of the Dominions has its own way of dealing with tariff applications. In Australia and New Zealand the Tariff Boards hold public hearings at which evidence is heard under oath, except in the case of witnesses resident outside those territories, who may submit written evidence supported by sworn testimony of its accuracy. United Kingdom manufacturers will generally find it more convenient to engage the services of experienced persons resident in those countries to give oral evidence on their behalf, and to be prepared to submit to a cross-examination on it. India and South Africa do not as a rule hold public hearings. In those cases documentary evidence from all parties is examined by departmental officials who publish their findings in due course.

While the various tariff authorities may adopt different methods, which may vary in detail and emphasis, electrical manufacturers would do well to bear in mind certain broad principles. The terms of reference should be studied carefully to ensure that the goods concerning which it is proposed to submit evidence do in fact come within the tariff item under review.

Interested manufacturers should give prompt notification —either directly or through their trade associations—that they intend to oppose an application for an increase in duty, otherwise the case may go by default. Preliminary notice may be given to the Board of Trade in London which will then notify the authority concerned. A reasonably long period is generally allowed for the preparation and submission of evidence. Several copies of written evidence are required.

Exporters should note that the Board of Trade *does not* enter an automatic protest, on behalf of interested parties, opposing a tariff increase application.

Nature of Evidence

All evidence should be factual and to the point. Theoretical arguments based on the evils of protection or the virtues of free trade should be avoided. Any reference to the damage likely to be suffered by United Kingdom industry, in the event of the requested increase being granted, should also be avoided. Unfavourable comparisons of a general nature should never be made between the United Kingdom industry and the industry seeking protection. To demonstrate statistically, however, that the indigenous industry has not the productive capacity to supply a large proportion of the home market is admissible. To suggest openly that the Dominion industry is inefficient is not to be recommended—to imply that it is uneconomic is a different matter.

To be able to prove, by using officially compiled statistics (e.g., census of production, or similar, figures) that the home market would still have to rely on a large proportion of imported goods—and that an increased duty would result in higher prices to the user—a very strong point will have been scored, since most countries are very sensitive to any likely rise in the cost of living.

Where a group of manufacturers submits a united case the names of all the individual manufacturers subscribing to the representations should be listed. Included in the evidence should be a statement showing what proportion of the industry's total output is made by the companies associated with the representations. A description of the particular section of the United Kingdom industry concerned may also form a part of the evidence showing briefly the number of persons employed on production,

their " award " rates of pay, and the output during a stated period.

A representative range of catalogues and other descriptive literature may also be included and one or more articles forming the subject of the inquiry may be submitted as exhibits. This will, of course, depend largely on the nature of the goods, but if samples are submitted they should be clearly labelled and identifiable. To be able to show that an article cannot be classified, or defined accurately and restrictively for duty purposes without extending protection to a large range of similar products not manufactured in the country concerned can be a very telling factor.

As already stated, both Australia and New Zealand require evidence to be given under oath at public hearings by the persons tendering it. Owing to the exacting nature of the evidence required, and the expense of sending one or more people from the United Kingdom to present evidence in person, special agencies have been established in those countries to represent British interests: they are the Australian Association of British Manufacturers—which maintains a branch office in London—and the United Kingdom Manufacturers' and New Zealand Representatives' Association, with headquarters in Wellington.

The " exacting " evidence required for Australian and New Zealand tariff inquiries takes the form of a complete breakdown of the manufacturers' production costs, selling price, etc. Information thus given will not be disclosed to any unauthorized persons. As the indigenous manufacturer or industry seeking protection is also required to give a cost break-down, British interests who are not prepared to do the same will certainly prejudice their position. Both the associations mentioned will co-ordinate and submit evidence on behalf of British manufacturers.

Whilst most tariff applications are designed to protect a local industry, cases do occur when an inquiry is instituted to have a duty reduced. Also, a request may be submitted to have a specified article withdrawn from a " dragnet " heading in order to determine an appropriate rate of duty for it. In these instances electrical exporters and manufacturers may themselves wish to initiate steps to have an official investigation made, in which event they are advised in the first instance to consult the Board of Trade in London. If a *prima facie* case exists the matter may then be referred to the appropriate Dominion authority.

Fuel Availability and Efficient Use

IN a paper presented at a conference on research and industrial productivity arranged by the Department of Scientific and Industrial Research, Mr. K. T. Spencer (Chief Scientist, Ministry of Fuel and Power) discussed the fuel situation in its various aspects. Coal consumption, he said, had remained relatively static in Great Britain for over 50 years at about 4 tons per head, which had been recently supplemented by imported petroleum equivalent to 0·5 ton per head, compared with a total of only 3 tons in Western Germany, for example. Overall energy consumption per inhabitant of the United States (26 per cent from natural gas) was two-thirds more than in Britain.

Although British coal reserves would last for quite 200 years, the gap between annual production and demand might reach 20 million tons within the next decade, but between 1965 and 1970 nuclear power stations were expected to provide the equivalent of that amount. The three ways of filling the gap during the next ten years were by increasing production in mining, importing fuel (principally petroleum) and improving efficiency of using energy. In spite of greater mechanization, coal production was unlikely to increase sufficiently to cover all requirements and its quality was declining.

Short of finding natural gas, the only immediate solution lay in importing more oil. The new B.E.A. power station at Marchwood would use 0·6 to 1·0 million tons per annum and six more stations were to be equipped for dual-firing (oil and coal). The most sensible way of filling the gap, however, was through increasing efficiency in use.

The railways consumed 14 million tons of coal a year (13 million as good quality large coal, being a quarter of the total of this type mined) at a low thermal efficiency which had hardly improved during the last century. An average overall figure was probably less than 5 per cent (6 to 7 per cent for express locomotives and under 3 per cent for shunting) compared with 19 per cent with electrification obtainable by burning 5 million tons of poor quality coal in power stations.

At the collieries about 10 million tons of coal was burned per annum to raise steam. In 1951, 3,900 shell boilers were in use, of which 3,400 were hand-fired, some burning good quality coal. Trials were being made of apparatus designed to burn slurry. The iron and steel industry was the largest single consumer of oil fuel (over one million tons last year) and, apart from the electricity and gas industries, it was the largest consumer of coal (33 million tons, including 26 million tons for coke ovens), and took 22·5 per cent of the national total.

General manufacturing industries (i.e., excluding iron and steel) accounted for over 75 per cent of all industrial coal consumption (36·4 million tons last year). In establishments using more than 2,000 tons a year (63 per cent of the total) there were 4,900 boilers, half of them of the shell type more than 30 years old with an average thermal efficiency of 61 per cent.

Present production of goods amounted roughly to £60 for each ton of coal burned (it should be £100 by 1965), giving an average cost of fuel equivalent to 7 per cent of their value. Figures varied widely between different industries. Typical examples tabulated showed a range of 1·2 per cent for cotton weaving to 44·8 per cent for pig iron (direct iron castings). Industries having a low fuel cost to value of product were not necessarily small consumers of fuel. Thus textiles with ratios of 1·2 to 2·3 per cent consumed nearly 15 per cent of all industrial coal, whereas cement with a fuel-cost proportion of 30 per cent took only 4·5 per cent.

Ratios of worst to best yields per ton of coal were shown to vary in certain industries from 6 to 40. Wastage occurred mainly in boiler houses. A recent investigation covering twenty breweries carried out by the British Coal Utilization Research Association revealed a variation of fuel consumption of between 3·5 and 12·6 therms per unit of product, half of which was due to differences in the utilization of heat; on an average about 1½ times more fuel was used than was necessary and some works used three times as much, the wastage occurring chiefly in boiler houses. Simple improvements were expected to save 200,000 tons of coal per annum at those breweries.

Rural Distribution

Progress Made in Experimental Work

By G. O. McLEAN, M.Eng.

SINCE 1937 when Messrs. Pask and Steel read a paper on rural distribution at the I.M.E.A. Convention, there has been a great deal of discussion on the subject and, more important still, quite an appreciable amount of research and experimental work, especially in the first five years of nationalization.

Although the 1947 Act made fourteen administratively convenient areas with balanced loads, each with some undeveloped rural land, the population and load-type characteristics of Area Boards are distinctly varied, as can be seen from Table 1, and the rural distribution problem falls heaviest on three Boards—the Southern, South Western and Eastern. Boards with a proportion of total units to domestic units per consumer greater than 2·5 can be considered as industrial and the financial burden of rural extensions can be spread more easily. Of the remaining Boards, London's elimination needs no argument, while the South Eastern population density of over 1,000 per square mile makes the problem a much easier one. Some thoughts on the problem and brief descriptions of some experimental work done in one of the three " rural " Boards are offered in this article.

Briefly, the rural distribution problem is to give reliable supplies of electrical energy to a widely scattered population at a price they can afford, which implies minimum losses and " oncosts," so that selling price is near to generating cost. Unfortunately, generating (or energy) costs are high in these areas because they are remote from coalfields, which means high freight and bulk supply charges, since the kWh charge is proportional to the " delivered coal cost."

Burden of Coal Costs

It is not always realized by those who make comparisons of electricity prices in different parts of the country that a difference of 50 per cent in regional coal prices (which existed in 1953) means approximately 20 per cent difference in bulk supply " unit prices " and this is the extent of the bias against rural Area Boards *before* the distribution and consumer service problems are faced.

An analysis of all Area Boards' accounts for the first five years of nationalization would reveal that energy costs were responsible for 65 per cent of the total costs, while the sections susceptible to the influence of the distribution engineer were 10 per cent for distribution operation and maintenance and 13 per cent for depreciation and interest on capital.

Capital Savings

The physical assets on which the annual charges have to be met vary in age from one year to thirty years, but on average there is about ten times as much old capital as new. In other words, the distribution engineer knows that he would have to make a 10 per cent saving in his current capital expenditure to effect a one per cent saving in annual charges, always assuming that the new capital will carry as much load for each £1 expended as the old, or produce as much revenue. In the same way the rural engineer, if he is not to increase the bias of generating costs against him, must ensure that his capital expenditure shall earn as much revenue per £1 as that of the more balanced areas. But since the " miles of mains " between consumers is far greater he must have far cheaper mains (and transformers and switchgear) even if his prospective consumers could afford to pay him as much revenue per head as higher paid industrial workers. Hence the obvious choice (or necessity) of using overhead lines wherever possible and, as a corollary, since insulating is easier overhead than underground, to use as high a voltage as possible and thus save on distribution losses.

Overhead Line Construction

" Mains and services " at about 45 per cent is the biggest single item amongst Area Boards' capital expenditure and one would normally look at it first when considering economies. Detailed analysis of any line construction project would disclose that from 60 to 75 per cent of the total costs have been allocated to materials and 20 per cent to labour. Of the materials, the conductor is the most expensive item, followed by poles, crossarms, insulators, stays and sundries. Except for the excellence of one's planning (and as described by the author elsewhere* this is dependent on accuracy of forecasting future loads from existing statistics) one can do very little about material costs since copper and aluminium prices are fixed by world conditions.

This international control emphasizes the importance of the planning staff to Area Boards, as a 0·1 sq in copper line will cost about 50 per cent less than a 0·15 sq in line, whatever happens to the price of copper. Naturally Area Boards are taking advantage of the fact that the use of aluminium conductor will save from 10 to 30 per cent of the capital cost of a line at present-day prices, though there is still considerable doubt whether

* *I.E.E. Journal*, Vol. 98, Part II.

TABLE 1: AREA BOARD CHARACTERISTICS
(1953–54 Reports)

Area Board	Area sq miles	Density of census population 1,000s/mile²	Proportion of population to consumers	Total kWh sold per consumer	kWh sold per domestic consumer, 1952-53	Proportion of total to domestic kWh
London	253	20·24	3·11	2,969	1,388	2·1
South Eastern ...	3,095	1·04	3·17	2,797	1,621	1·7
Southern	6,528	0·58	3·52	3,153	1,477	2·1
South Western ...	5,560	0·38	3·40	2,529	1,303	1·8
Eastern	7,763	0·61	3·35	3,273	1,577	2·1
East Midlands ...	6,244	0·59	3·38	3,704	1,312	2·8
Midlands	5,075	0·81	3·54	4,771	1,459	3·3
South Wales ...	4,568	0·43	3·91	6,261	964	6·5
Merseyside	4,738	0·60	3·75	4,037	1 284	3·1
Yorkshire	4,094	1·02	3·28	4,302	1,177	3·6
North Eastern ...	5,670	0·52	3·80	4,060	951	4·2
North Western ...	4,755	0·96	3·18	4,078	1,232	3·2
S.E. Scotland ...	3,160	0·42	3·60	3,046	1,102	2·7
S.W. Scotland ...	4,997	0·52	3·45	3,740	1,229	3·0
	66,500	0·71	3·40	3,709	1,330	2·8

aluminium conductors will have the same life as copper. Experiments continue to be made with steel wire, but life uncertainty is again a serious deterrent. The prices of other materials, particularly poles and insulators, are also controlled by suppliers and not users, though the latter may be able to suggest changes in design which may effect economies.

The distribution engineer is thus left with labour costs as the only item in which economies can be made and, as has been pointed out above, this item is generally not more than 20 per cent of the total construction cost. "Labour costs" are synonymous with "man-hours" and the universally recognized method of reducing these is to institute piece-work, but this is apparently banned in the supply industry in this country, although Scandinavian engineers give it as one of the main reasons for their own low construction costs.

A second method of increasing productivity is the use of mechanical power in place of manpower, and the greatest field for application in overhead line construction work has been the digging of pole holes. Since the pioneering work done by the old Shropshire Company with American machines, many types and sizes of pole hole diggers have been built and used in this country, but in the author's opinion they have all been too heavy for use on farm land, too cumbersome for movement into awkward pole positions and, above all, too expensive to justify their use on light rural lines. What has been needed is a light four-wheel drive, short wheelbase machine, which is also flexible in the uses to which it can be put.

After a great deal of experimenting with types and sizes of augers, chucks and driving speeds, and the greatest amount of co-operation from the Consolidated Pneumatic Tool Company, it is felt that the machine illustrated in Fig. 1 fits the general specification and yet is made up from standard equipment.

The transporting machine is a standard "Land Rover" which houses and drives a 60 cu ft 100 lb/sq in compressor which can be fitted by any of a dozen makers. This supplies power to a standard C.P. 350 consolidated power vane suspended from and guided by a light steel frame which can be fitted to and detached from the chassis of the "Land Rover" in a few minutes. The power vane can drive a simple helical auger from 6in to 18in diameter to a depth of 6ft or 7ft and lift the spoil from the hole in reasonable quantities.

Fig. 1.—Pneumatic earth drill mounted on a "Land Rover"

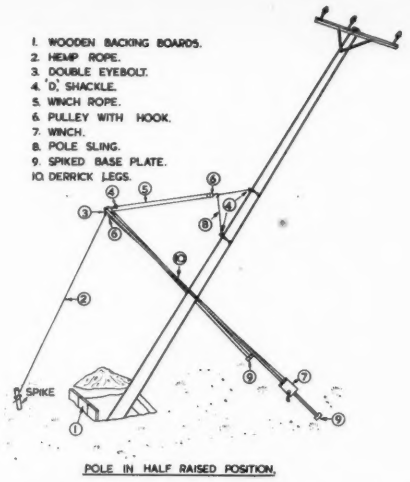


Fig. 2.—Principle of operation of two-legged pole hoisting derrick

The major advantage of the compressed air driven machine is the facility provided for clearing the hole, as it has been found with this and other machines that in waterlogged ground there is such closeness of fit between the withdrawing auger and the hole it has cut that the vacuum created on the underside is sufficient to add several tons load to the lifting tackle. With an air supply it is only necessary to push a ½in tube down through the spoil to the underside of the auger and turn on the air and the auger and spoil are "assisted" out of the hole. Further advantages are that when working in rocky ground a simple power driven auger can be changed for a compressed air rock drill, while the same machine and compressor can be used for the normal pneumatic tools for concrete and road work. Only two men are required for operating the machine on any of its functions, and though the rate of drilling may be lower than with some of the heavy high powered machines, the author is convinced that the cost per hole will be much lower than by any other means.

Pole Erection

Another heavy drain on manpower expenditure is that caused by pole erection, particularly where a heavy line on 36ft stout poles is being constructed, mainly because of the awkwardness of the load that has to be raised into the vertical position. A two-legged derrick has been devised in the South West to enable any of these poles to be erected by two men in less than half an hour, and Fig. 2 shows the principle of operation of the derrick. It will be noticed that the pole itself acts as the third and main leg of a tripod. The operators have merely to set the legs of the derrick in position, having already placed the butt of the pole over the hole that has been drilled, and then wind up on the winch which is attached to one leg of the derrick. The effect of this winding is to raise the derrick off the ground into a lifting position, and thereafter a further shortening of the hoist rope raises the pole until it slides into the hole.

Transformer Loading

The transformer between the h.v. and l.v. systems is the next large item of expenditure in rural distribution work, and while again the suppliers fix (or quote) the prices, the engineer can influence his overall costs by

careful planning and ensuring that his plant load factor is the most economical.

As indicated in previous articles* the author has investigated the possibility of operating distribution transformers at heavier loads than is the present-day practice, and is convinced that considerable savings could be made by taking advantage of the air conditions round pole-mounted transformers and postponing transformer changes until a considerable amount of overload had been reached.

After transformers, switchgear is the next item of expenditure in which economies may be possible, and just as the majority of, if not all, l.v. systems are controlled by h.r.c. fuses, so there would appear to be some scope for the elimination of expensive switchgear on the 11 kV systems. Transformers are so reliable nowadays that they do not need to be protected by breakers, and many of the short spur lines can similarly be connected solidly to the main 11 kV system. Naturally, there have to be a certain number of automatic disconnection points which can consist of switch fuses backed up at the major substations with other circuit breakers.

As is well known, many of the faults on overhead lines are of a transient nature, and it has been recognized for some time that a great number of operational man-hours could be saved if the breakers could be reclosed automatically. Where the breakers are power operated this can be done quite easily if a suitable discriminating relay is interposed in the tripping and closing circuits. A relay of this type has been devised by one of the engineers in the South Western area.

L.V. Service Costs

Whatever savings the distribution engineer is able to effect on his overhead line construction, he realizes that more than half the total cost of supplying his consumers is attributable to the l.v. mains and services. The simplest of overhead services from the main in the street to a consumer's premises in the past cost £8 to £15. Again, though the minimum amount of materials cost about £3 to £4 the only real scope for improvement is in reduction of man-hours, which means a new technique in making the connections at the two ends of the service line. Following on about eighteen months of experimenting with different types of conductor and tensioning methods, means have now been adopted which it is confidently expected will provide individual services at a cost of about £5 each. Detailed costs are given in Table 2 and the main features of the pole end of the line are shown in Fig. 3.

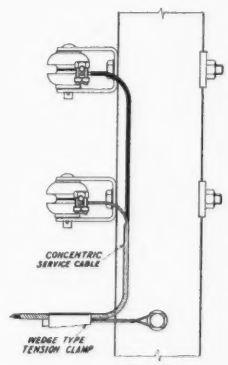


Fig. 3.—Pole end of house service

It will be noticed that the distinguishing features are the use of a concentric cable with one thickness (50 mils) of p.v.c. insulation between live core and earthed neutral and tensioning between the two suspension points by means of a wedge type clamp. It has been realized that the method involves multiple earthing (protective or not) to ensure freedom from a potential above earth on exposed conductors in consumers' premises, but the experiments have received the greatest encouragement from Ministry officials, and no difficulties have so far been experienced.

Earlier reference was made to the use of the highest possible voltage in order to save losses, and the author feels that the time is almost upon us when 11 kV will be the distributing voltage right up to domestic premises, though it is realized that this will involve much cheaper transformers, and that their construction will have to be of the C wound core type so as to have extremely low iron losses. Given these conditions there will possibly be a saving of 20 per cent on the present distribution costs, involving large quantities of l.v. copper.

TABLE 2. COSTS OF CONCENTRIC CABLE OVERHEAD SERVICE

	£	s	d
15 yd of p.v.c. insulated cable (twin ·0225 sq in)	2	0	0
2 wedge type clamps		5	0
Line taps		1	3
Coach hook, D iron, clips, etc.		2	3
Meter board, fuse box with h.r.c. fuse and neutral link		14	0
Materials	£3	2	6
Stores oncosts 10 per cent		6	3
	£3	8	9
Labour			
Linesman and mate (3 hours)		17	7
Transport			
Van, 3 hours at 4s per hour		12	0
TOTAL	£4	18	4

Glass Manufacturers' Federation

THE annual general meeting of the Glass Manufacturers' Federation was held on 14th December at the Federation's offices, 19, Portland Place, London, W.1.

In moving the adoption of the report for 1954, Mr. E. A. S. Alexander said that the great event of the year was the opening of the new headquarters at 19, Portland Place. There was abundant evidence of the enthusiasm with which the centre had been received and the industry now had a base from which to work with greater effect for members. In view of the widely differing products made by members of the Federation, the conclusion had been reached that publicity could only be satisfactorily developed sectionally, and projects covering domestic glass, lighting glass, glass containers and vacuum flasks had been or were being formulated, and it was hoped that other sections would make known their requirements so that the services could be extended. The establishment of the British Glass Industry Research Association was of great significance and the Federation wished it every success and looked forward to collaborating with it and other organizations.

Mr. Alexander was re-elected president of the Federation for the ensuing year, Dr. W. Maskill was re-elected chairman of the Executive Committee, and Mr. A. W. Clark was elected vice-chairman of the Executive Committee.

At the annual luncheon held at the Hyde Park Hotel on the same day, Mr. Peter Thorneycroft, President of the Board of Trade, said that whilst it was up to industry to meet the needs and demands of customers, the Government bore some responsibility for maintaining the impetus of demand. Conditions had been created in which industry could trade and he was sure that the glass industry would make the most of them. The industry shared to the full in the forward march of events; the volume of exports for the first nine months of this year was 8 per cent higher than in 1953.

Mr. Alexander, in responding, said that in 1915 the first chair of glass technology of university status in the world had been established at Sheffield, where the Department of Glass Technology has since undertaken central research. An extension of research was made this year when the British Glass Industry Research Association had been inaugurated. The industry had greatly increased its production and the country had changed from its pre-war position of importing glassware to a virile exporter. In the first ten months of 1954, exports of glass and glassware were valued at nine times those in the same period of 1938.

* McLean and Peacock, "Distribution Transformers," *Electrical Review*, 26th December, 1952; "Transformer Loading," *Electrical Review*, 2nd January, 1953.

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Fluorescent Handlamps

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A fluorescent barrel inspection lamp also available incorporates an 8 W tube and measures 39in overall, weighing approximately 2 lb. Complete with handle, control gear and 25ft of rubber flexible, the price is £8 5s 6d plus 1s 8½d purchase tax.

Domestic Refrigerator

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The apparatus measures 21¾in by 23¾in (excluding door fittings) by 36¼in high (plus 1⅜in for ventilation louvre). External finish is in high gloss white enamel, the interior is porcelain enamelled and the inner door panel is of plastic material.

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E.M.I. measuring oscilloscope

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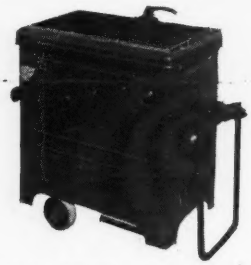
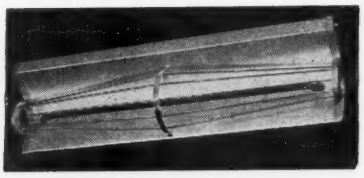


Quasi-Arc ACP190 welding transformer

Safety Heater

The new high level, reflecting heater announced by HEATRAE, LTD., Heatrae Works, Norwich, is designed for wall mounting, the principal feature being that it provides a flood of warmth rather than a beam of heat, thus making it ideal for the bathroom or nursery. The long, wide-angled reflector is finished in chromium and the end panels are of stoved enamel aluminium. A 750 W embedded type rod element is fitted and the design permits all live parts to be totally enclosed. The standard colour finish is mushroom. The price of the "Saferod," which is suitable for operation at 200/220 V or 230/250 V, is £3 19s plus £1 8s 10d purchase tax in the United Kingdom.

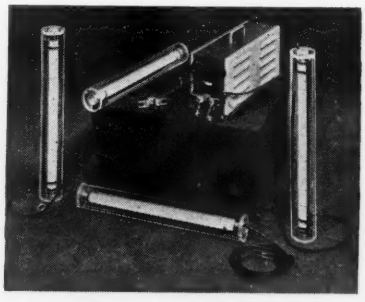


Heatrae "Saferod" safety heater

Portable Fluorescent Lighting

The "Atlas" portable fluorescent equipment which has been developed by THORN ELECTRICAL INDUSTRIES, LTD., 105–109, Judd Street, London, W.C.1, is claimed to overcome disadvantages sometimes experienced with portable lighting using tungsten filament lamps.

The system provides an operator with a fully insulated portable lighting unit in which 2ft 40 W fluorescent tubes are enclosed in clear "Perspex" cylinders.



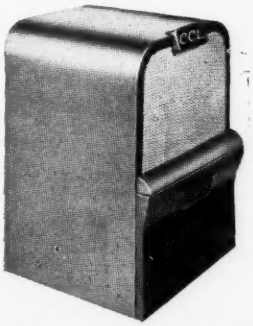
"Atlas" portable fluorescent lighting equipment

It is particularly suitable for general lighting inside aircraft during construction since the equipment can be used with safety in moist or humid conditions and in restricted space, and is designed for operation on a 110 V 50 c/s supply which normally has a potential of 55 V between each conductor and earth. The running voltage across the fluorescent tube is only 50 V.

The control box is 19in long by 11in high and 6½in wide and weighs 25 lb. It is provided with a neat carrying handle and is finished in grey enamel.

Air Drying Unit

The "Moisture Master" air dryer recently placed on the market by CONTINENTAL COMPONENTS, LTD., 35/39, Maddox Street, London, W.1, has been produced in response to a demand for a small air drying unit, as opposed to a room air conditioner, which is capable of removing of moisture from an enclosed space. Simple in operation, it has an area capacity of 10,000 cu ft and incorporates a ⅛ h.p., 220 V, 50 c/s motor.



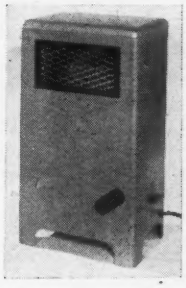
"Moisture Master" air drying unit

Water, dust, pollen, etc., are removed from the air by cooling coils and led to a water drawer for disposal. Dried air then passes over the condenser coils where it is reheated and passed back to the room. The rust-proofed water drawer can be used as a container or, with stopper removed, can discharge into a drain. The hermetically sealed unit requires no oiling and all moving parts are sealed against air moisture and dirt. The refrigerant used is "Freon 12."

Fitted with castors for easy movement, the cabinet measures 21in high by 20½in long by 12in wide and weight is 94 lb. The price is £45, ex works.

Console Heater

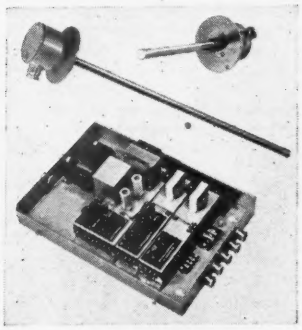
The new electric console heater now being marketed under the trade name of "Airotherm" by the CARTER ELECTRICAL CO., LTD., Eastern Works, Eastern Avenue, Romford, Essex, is, in fact, a miniature air conditioner. It incorporates a 2 kW element, which can be switched to half or full heat, and a built-in fan for the circulation of warm air. Of robust construction, the "Airotherm" is 22in high by 13in wide and 8½in deep and is produced in a mid-bronze with a hammered finish. Provision is made for radio/television interference suppression. Models are available for standard a.c. voltages, 200/250 and 100/120, and for d.c. voltages at slightly extra cost. The retail price is £9 plus £2 19s 3d purchase tax in the United Kingdom.



Carter Electrical Co. "Airotherm" console heater

Temperature Control Equipment

The series E9 electronic compensated control equipment with thermistor temperature detectors made by THERMOCONTROL INSTALLATIONS CO., LTD., 2–10, Valentine Place, London, S.E.1, is designed for temperature control for heating, ventilating and air conditioning. It is adaptable to numerous applications where compensated control is required or the control level is regulated with respect to several variables.



Thermocontrol temperature control equipment

The thermistor elements are made by a special process (for which patent applications have been made) resulting in a sensitivity which enables them to be used with a simple and reliable electronic relay. The advantage of the system is that shielding of interconnecting wiring between the various elements is not necessary excepting where extreme lengths of run are used. The system is based on the Wheatstone bridge circuit and, according to the temperature at the various measuring points, the voltages from the bridges add to or subtract from a resultant voltage which, via electronic relays, positions the controlling unit.

Greenhouse Heater

The new "Raydair" greenhouse heater announced by BERRY'S ELECTRIC, LTD., Touchbutton House, Newman Street, London, W.1, is a free-standing model suitable for greenhouses up to 600 cu ft in size. It is compact, waterproof and protected against rust. Provision is made for variable humidity by means of an all-copper evaporating trough heated by convection from the 1½ kW element. The heater is 19¼in high by 30½in wide by 7½in deep and weighs 16¾ lb, the price being £9 plus £2 2s for the thermostat.

Berry's 1½kW "Raydair" greenhouse heater

Time Delay Interlocking Device

The "Castell" delay action key exchange for time delay interlocking manufactured by CASTELL LOCKS, LTD., 30, Woburn Place, London, W.C.1, consists of a compact unit containing a clockwork mechanism and two keys of different combinations, the movements of the upper one serving automatically to keep the time-lag train energized. The upper key commands a first operation, completion of which permits the key to be brought to the exchange unit in which the lower key is held trapped. Turning of the upper key traps it and releases the lower key for removal, but only after a predetermined time interval, which may have a maximum duration of sixty minutes. Standard delay times range between one and twelve minutes. Release of the lower key is announced by the ringing of a bell and the change of a colour in an indicator target.

"Castell" delay action key exchange

Coffee Percolator

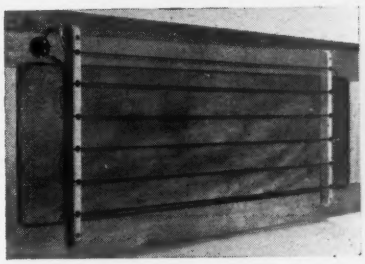
A coffee percolator introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, is of pleasing design and has a capacity of 1½ pints. An automatic re-set device protects the percolator in the event of its being switched on when empty or boiling dry. The body is of heavy gauge copper finished in chromium plate. The heat insulated handle and feet are of black Bakelite and the appliance is supplied with 6ft of 3-core braided flex. The loading is 400 W and the price £6 5s.

G.E.C. 1½-pint coffee percolator

Piano Heater

An electrically-heated air conditioner specially designed for pianos has recently been placed on the market by the WARM-GLOW CO., LTD., Progress Road, Leigh-on-Sea, Essex. It consists of a length of plastic-covered cable, with a loading of about 50 W, which attains a temperature only a few degrees above that of the atmosphere so that it can safely be left switched on, thus preventing dampness in the instrument. The heater is supplied with a special mains plug and socket, fixing screws, etc., and can be installed on the lower front panel of the piano in an hour. It is suitable for use on 200/250 V or 100/130 V and the price is £1 10s.

"Warm-Glow" piano heater fitted to the lower panel of a piano



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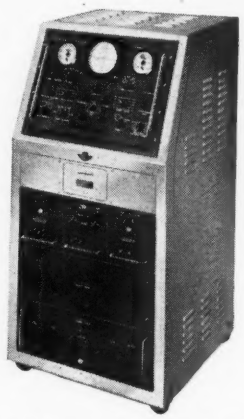

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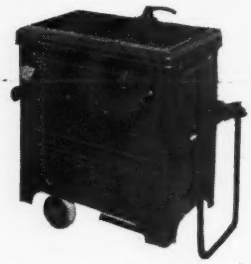
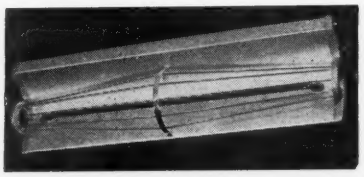


Quasi-Arc ACP190 welding transformer

Safety Heater

The new high level, reflecting heater announced by HEATRAE, LTD., Heatrae Works, Norwich, is designed for wall mounting, the principal feature being that it provides a flood of warmth rather than a beam of heat, thus making it ideal for the bathroom or nursery. The long, wide-angled reflector is finished in chromium and the end panels are of stoved enamel aluminium. A 750 W embedded type rod element is fitted and the design permits all live parts to be totally enclosed. The standard colour finish is mushroom. The price of the "Saferod," which is suitable for operation at 200/220 V or 230/250 V, is £3 19s plus £1 8s 10d purchase tax in the United Kingdom.

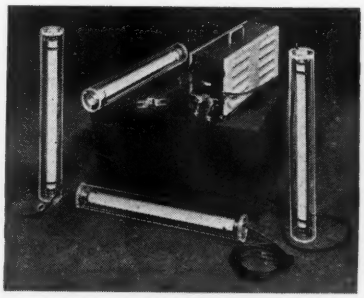


Heatrae "Saferod" safety heater

Portable Fluorescent Lighting

The "Atlas" portable fluorescent equipment which has been developed by THORN ELECTRICAL INDUSTRIES, LTD., 105–109, Judd Street, London, W.C.1, is claimed to overcome disadvantages sometimes experienced with portable lighting using tungsten filament lamps.

The system provides an operator with a fully insulated portable lighting unit in which 2ft 40 W fluorescent tubes are enclosed in clear "Perspex" cylinders.



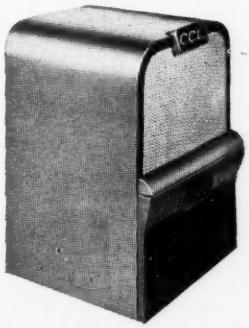
"Atlas" portable fluorescent lighting equipment

It is particularly suitable for general lighting inside aircraft during construction since the equipment can be used with safety in moist or humid conditions and in restricted space, and is designed for operation on a 110 V 50 c/s supply which normally has a potential of 55 V between each conductor and earth. The running voltage across the fluorescent tube is only 50 V.

The control box is 19in long by 11in high and 6¼in wide and weighs 25 lb. It is provided with a neat carrying handle and is finished in grey enamel.

Air Drying Unit

The "Moisture Master" air dryer recently placed on the market by CONTINENTAL COMPONENTS, LTD., 35/39, Maddox Street, London, W.1, has been produced in response to a demand for a small air drying unit, as opposed to a room air conditioner, which is capable of removing of moisture from an enclosed space. Simple in operation, it has an area capacity of 10,000 cu ft and incorporates a ⅛ h.p., 220 V, 50 c/s motor.



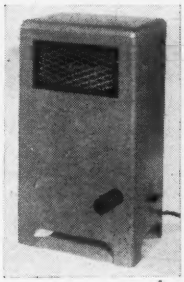
"Moisture Master" air drying unit

Water, dust, pollen, etc., are removed from the air by cooling coils and led to a water drawer for disposal. Dried air then passes over the condenser coils where it is reheated and passed back to the room. The rust-proofed water drawer can be used as a container or, with stopper removed, can discharge into a drain. The hermetically sealed unit requires no oiling and all moving parts are sealed against air moisture and dirt. The refrigerant used is "Freon 12."

Fitted with castors for easy movement, the cabinet measures 21in high by 20½in long by 12in wide and weight is 94 lb. The price is £45, ex works.

Console Heater

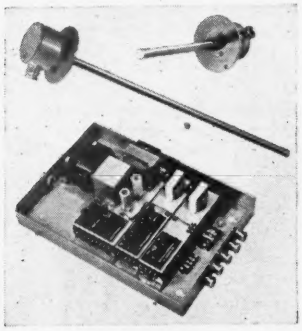
The new electric console heater now being marketed under the trade name of "Airotherm" by the CARTER ELECTRICAL CO., LTD., Eastern Works, Eastern Avenue, Romford, Essex, is, in fact, a miniature air conditioner. It incorporates a 2 kW element, which can be switched to half or full heat, and a built-in fan for the circulation of warm air. Of robust construction, the "Airotherm" is 22in high by 13in wide and 8½in deep and is produced in a mid-bronze with a hammered finish. Provision is made for radio/television interference suppression. Models are available for standard a.c. voltages, 200/250 and 100/120, and for d.c. voltages at slightly extra cost. The retail price is £9 plus £2 19s 3d purchase tax in the United Kingdom.



Carter Electrical Co. "Airotherm" console heater

Temperature Control Equipment

The series E9 electronic compensated control equipment with thermistor temperature detectors made by THERMOCONTROL INSTALLATIONS CO., LTD., 2–10, Valentine Place, London, S.E.1, is designed for temperature control for heating, ventilating and air conditioning. It is adaptable to numerous applications where compensated control is required or the control level is regulated with respect to several variables.



Thermocontrol temperature control equipment

The thermistor elements are made by a special process (for which patent applications have been made) resulting in a sensitivity which enables them to be used with a simple and reliable electronic relay. The advantage of the system is that shielding of interconnecting wiring between the various elements is not necessary excepting where extreme lengths of run are used. The system is based on the Wheatstone bridge circuit and, according to the temperature at the various measuring points, the voltages from the bridges add to or subtract from a resultant voltage which, via electronic relays, positions the controlling unit.

Greenhouse Heater

The new "Raydair" greenhouse heater announced by BERRY'S ELECTRIC, LTD., Touchbutton House, Newman Street, London, W.1, is a free-standing model suitable for greenhouses up to 600 cu ft in size. It is compact, waterproof and protected against rust. Provision is made for variable humidity by means of an all-copper evaporating trough heated by convection from the 1½ kW element. The heater is 19¼in high by 30½in wide by 7½in deep and weighs 16¾ lb, the price being £9 plus £2 2s for the thermostat.

Berry's 1½ kW "Raydair" greenhouse heater

Time Delay Interlocking Device

The "Castell" delay action key exchange for time delay interlocking manufactured by CASTELL LOCKS, LTD., 30, Woburn Place, London, W.C.1, consists of a compact unit containing a clockwork mechanism and two keys of different combinations, the movements of the upper one serving automatically to keep the time-lag train energized. The upper key commands a first operation, completion of which permits the key to be brought to the exchange unit in which the lower key is held trapped. Turning of the upper key traps it and releases the lower key for removal, but only after a predetermined time interval, which may have a maximum duration of sixty minutes. Standard delay times range between one and twelve minutes. Release of the lower key is announced by the ringing of a bell and the change of a colour in an indicator target.

"Castell" delay action key exchange

Coffee Percolator

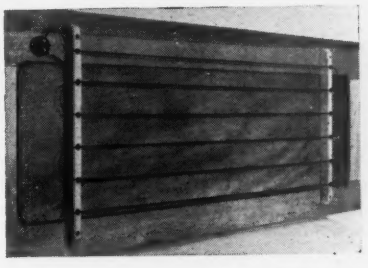
A coffee percolator introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, is of pleasing design and has a capacity of 1½ pints. An automatic re-set device protects the percolator in the event of its being switched on when empty or boiling dry. The body is of heavy gauge copper finished in chromium plate. The heat insulated handle and feet are of black Bakelite and the appliance is supplied with 6ft of 3-core braided flex. The loading is 400 W and the price £6 5s.

G.E.C. 1½-pint coffee percolator

Piano Heater

An electrically-heated air conditioner specially designed for pianos has recently been placed on the market by the WARM-GLOW CO., LTD., Progress Road, Leigh-on-Sea, Essex. It consists of a length of plastic-covered cable, with a loading of about 50 W, which attains a temperature only a few degrees above that of the atmosphere so that it can safely be left switched on, thus preventing dampness in the instrument. The heater is supplied with a special mains plug and socket, fixing screws, etc., and can be installed on the lower front panel of the piano in an hour. It is suitable for use on 200/250 V or 100/130 V and the price is £1 10s.

"Warm-Glow" piano heater fitted to the lower panel of a piano



GENERATION AND DEVELOPMENT

Boards' Sales in November

Electricity output figures for November were published in our last issue (page 1022). The accompanying table analyses the Area Boards' sales. The national figures show an increase over November, 1953, of 14·5 per cent, but when corrected for weather conditions, which were colder than a year earlier, and the number of effective working days (27·7 against 27·36), the increase is 11 per cent.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for November (million kWh)			Twelve Months Totals Ended 30th November (million kWh)		
	1953	1954	Inc. or Dec. %	1953	1954	Inc. or Dec. %
London	534·7	591·1	+10·5	5,656·5	6,007·8	+ 6·2
South Eastern...	305·8	338·5	+10·7	3,332·6	3,605·8	+ 8·2
Southern	362·9	417·8	+15·1	3,910·2	4,277·9	+ 9·4
South Western	176·3	215·5	+22·2	1,893·1	2,190·8	+15·7
Eastern	502·5	566·3	+12·7	5,414·7	5,872·6	+ 8·5
East Midlands*	422·0	498·4	+18·1	4,627·5	5,028·8	+ 8·7
Midlands*	580·1	660·2	+13·8	6,133·1	6,764·6	+10·3
South Wales*	320·3	366·0	+14·3	3,452·8	3,907·7	+13·2
Merseyside & N. Wales* ...	316·9	374·6	+18·2	3,439·5	3,864·9	+12·4
Yorkshire*	558·8	637·1	+14·0	6,012·9	6,564·6	+ 9·2
North Eastern*	335·8	367·2	+ 9·4	3,616·8	3,891·3	+ 7·6
North Western*	623·8	702·9	+12·7	6,698·3	7,332·1	+ 9·5
South East Scotland	123·0	141·6	+15·1	1,287·8	1,432·6	+11·2
South West Scotland* ...	297·7	338·7	+13·8	3,103·3	3,383·1	+ 9·0
Total all Area Boards ...	5,460·6	6,215·9	+13·8	58,579·1	64,124·6	+ 9·5
Direct Supplies by Central Authority	83·1	135·2	+62·7	939·5	1,224·7	+30·4
Grand Total	5,543·7	6,351·1	+14·5	59,518·6	65,349·3	+ 9·8
Mainly Industrial Areas* ...	3,455·4	3,945·1	+14·2	37,084·2	40,737·1	+ 9·9
Mainly Non-Industrial Areas	2,005·2	2,270·8	+13·3	21,494·9	23,387·5	+ 8·8

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

Turf-Fired Power Station

Work has begun at Ferbane, Co. Offaly, on a large turf-fired station for the Eire Electricity Supply Board.

The buildings will include a boiler house, engine room, switch buildings, stores and control buildings, and on the site development, light railways, roadways, drainage, etc., as well as the foundations for the turf handling equipment. The station will be the first of its kind outside the U.S.S.R. to use milled turf. The first development is due for completion in 1955–57, and will have an output of approximately 240 million kWh a year. The station, when completed, will raise the output to 400 million kWh, using 920,000 tons of milled turf a year. Two other large turf stations are planned at Lanesboro, Co. Longford, and Derrygreenagh, Co. Offaly, while work is proceeding on four small stations to use hand-won turf at Cahirciveen, Miltownmalby, Screeb (Galway), and Gweedore.

Gisla Hydro-Electric Scheme

The North of Scotland Hydro-Electric Board has announced details of its Gisla (Lewis) (Constructional Scheme No. 34) Hydro-Electric Scheme which will produce approximately 2,000,000 kWh a year. The scheme provides for harnessing the waters of the Gisla River (Amhuinn Gisladh) which flows out of Loch Grunnabhat in the parish of Uig on the west coast of Lewis and has a catchment area of some five square miles. By means of a diversion aqueduct, a further two square miles of an adjacent catchment will be utilized. A dam, 300ft long and of 27ft maximum height, will be built across the Gisla River. From the dam, water will be led by pipeline 2,700ft long, to a power station, with a capacity of 600 kW situated at the mouth of the Gisla River where it enters Little Loch Roag. At present there are at Stornoway diesel engine generators with a total capacity of 3,600 kW which produced 8,600,000 kWh in 1953 for the island of Lewis. The Gisla scheme will supply additional power in order to meet the rapid growth of demand. The Board recently published a scheme for Loch Chliostair in Harris to supply the electricity network which is being built there. The Harris and Lewis networks are connected by a 33 kV line from Stornoway to Tarbret, Harris.

Generation in Japan

Electric power generating companies in Japan made an unexpected profit of 11,000 million yen during the first half of the financial year. This was because higher average rainfall enabled many run-of-the-stream hydro-electric stations to be kept in operation, with substantial economies in the working of thermal stations. Two new hydro-electric stations were completed on the Tadami River in October. These are capable of developing between them 94,600 kW, which brings the total generating capacity of the stations along the river to 501,300 kW.

Overhead Cables in Ulster

The question of the erection of overhead electric cables by the Northern Ireland Electricity Board will be discussed at the January meeting of the Association of Municipal Authorities of Northern Ireland. There is strong feeling on the subject among several local authorities in Ulster, who are in favour of pressure being brought on the Government to ban the erection of overhead cables.

It is pointed out that in English seaside resorts all cables must be laid underground, to avoid interference with the appearance of the towns. Other grounds of objection were put forward at a recent meeting of Bangor (Co. Down) Borough Council, when a member stated that cables recently erected interfered with television sets to such an extent that the sets were useless.

Jersey Electric Cooking Campaign

The Jersey Electricity Co., Ltd., recently held a Philip Harben show on the lines of those organized by several Electricity Boards. As a result of the efforts of Miss A. M. Carter, in charge of the company's publicity, on 8th December there were full houses at Springfield Theatre both for the afternoon and evening shows. Mr. W. K. Allen, managing director, tells us that the show was a great success, and that his company is following up with an "at home" to the housewives of Jersey. This will be held at West Park Pavilion, St. Helier, early in the New Year when Marguerite Patten will be the guest.

Queensland Hydro-Electric Plant

Somerset Dam, Queensland, a mass gravity structure having a storage capacity of 724,000 acre-feet, was built by the Stanley River Works Board primarily to provide water for Brisbane and to mitigate floods. It was decided to install also hydro-electric plant and the dam was provided with a 9ft diameter steel-lined tunnel leading to a power station containing a 3,200 kW 375 r.p.m. water-turbine generating set supplied by Boving & Co. A double-runner turbine of the Francis type is coupled to a 4,000 kVA 0·8 power factor water-wheel generator, which with the switch and control gear was supplied by Metropolitan-Vickers Electrical Co., Ltd.

The generator is a standard horizontal machine with closed air-circuit ventilation. The generating set can be controlled either locally or from a substation above the flood level 120 yd away. The power generated is stepped up from 11 to 33 kV and fed into the ring main of the Southern Electricity Authority.

Portuguese Power Distribution

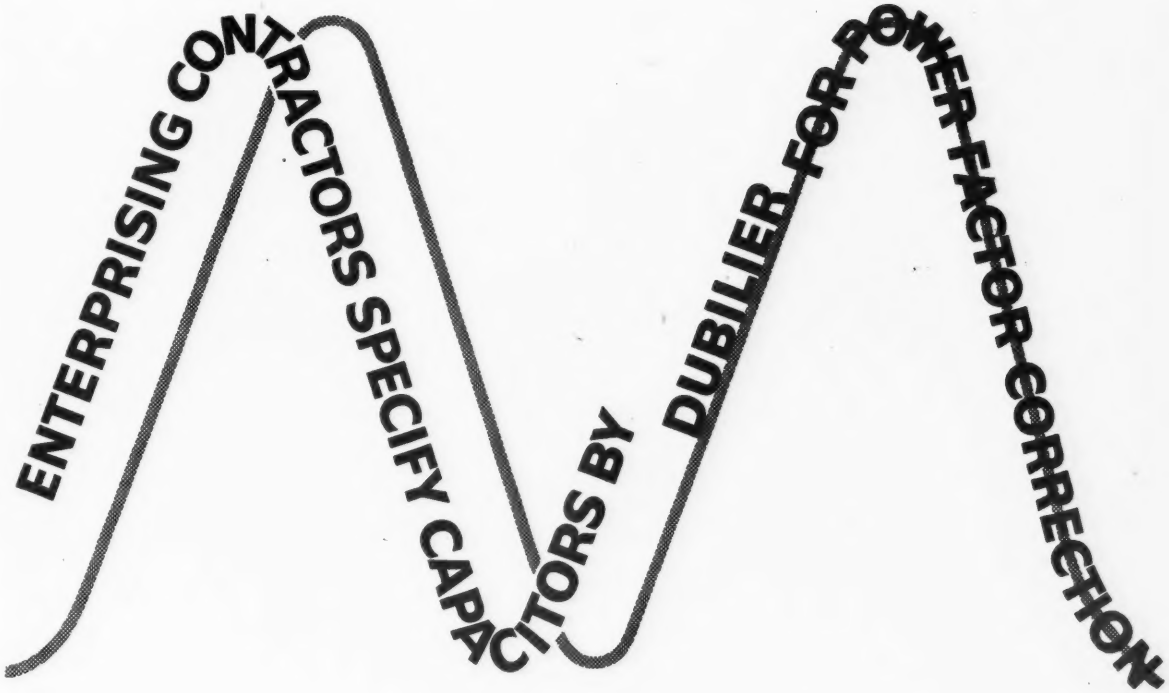
A new company, Cia. Electrica de Alentejo e Algarve, has been formed recently for the transmission and distribution of electricity in the districts of Alentejo and Algarve. The distribution system to be constructed by the company will extend to about 600 km. The project will cost some 100 million escudos (£1¼ million) and take about six years to complete.

A 300 MW Generator

Mr. Walker L. Cisler, president of the Detroit Edison Co., has announced that his company has ordered a 300 MW turbo-generator set for its River Rouge plant. The company already has a 260 MW set going into commission early in 1956 and a similar one scheduled for the following year.

Bombay Power Station

A loan of $16·2 million towards the total cost of $27·5 has been granted by the World Bank to the Tata Hydro-Electric, the Tata Power and the Andhra Valley Power Supply Companies for the erection of their new thermal station on Trombay Island near Bombay. The station, with a main substation and transmission lines, is to be completed by the end of 1957.

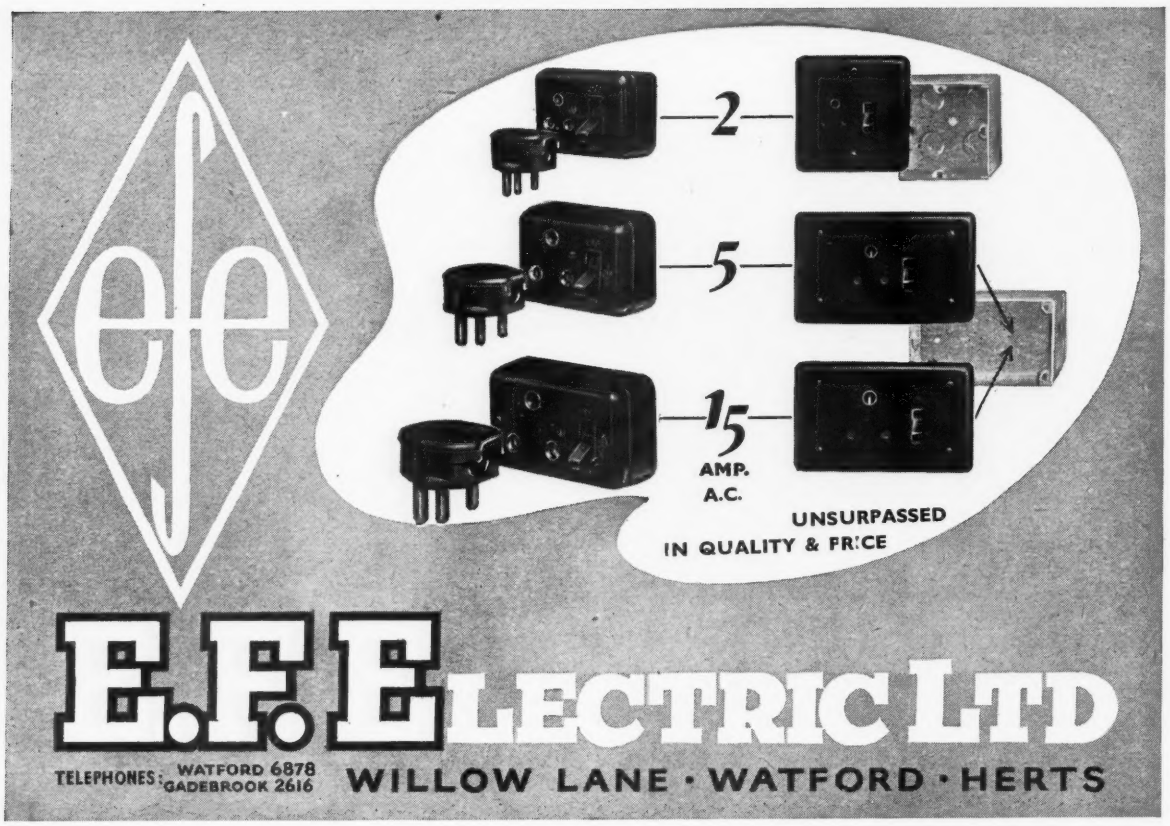


DUBILIER

Dubilier Condenser Company (1925) Ltd., Ducon Works, Victoria Road, North Acton, London, W.3

Phone : ACOrn 2241 (5 lines). Gram : Hivoltcon Wesphone. London Marconi Inter Code

DN 113



The Chairman said . . .

IF THE WALLS HAD TONGUES in London's Connaught Rooms and they were in good voice and reminiscent mood, what a captivated audience we should all become.

"Last night," they would begin; and then one would speak of a little dinner party, small in numbers but great in wit; while another would recall an eve-of-the-Show banquet for a thousand leaders of a growing industry. The principal guest of a learned society had been a person very important indeed. Tall tales were told at the dinner of a mountaineering club, and long ones at others. For it takes all sorts of dinners to make an evening at the Connaught Rooms, and the Connaught Rooms alone can make a memorable evening for so many. No other city on earth can boast anything to equal or even to approach this supernacular organisation of twenty sumptuous banqueting rooms, grouped under one roof. Many and various indeed are the functions of the Connaught Rooms. Banquets take pride of place, but no less perfect are the arrangements for cocktail parties, receptions and weddings, for company meetings and trade exhibitions.

In the Entrance Hall, there's another service for the benefit of our customers and their friends — a bureau where you'll find all your travel and entertainment bookings are looked after with smooth efficiency.

CONNAUGHT ROOMS *are Banqueting Rooms*

TELEPHONE: HOLBORN 7811

P.S. Everyone electrical meets at the Connaught Rooms

Financial Section

REPORTS and DIVIDENDS

Associated Electrical Industries, Ltd., has announced details of its offer for the ordinary capital of Siemens Brothers & Co., Ltd. It proposes to offer seven A.E.I. £1 ordinary shares in exchange for ten Siemens £1 ordinary. The offer is conditional upon 90 per cent acceptance not later than 24th January or such smaller percentage or later date as may be agreed between the two boards. Treasury consent has been obtained. A.E.I. forecasts a final dividend of 10 per cent, making 14 per cent on £17,741,192 ordinary stock for 1954, as compared with the equivalent of 11¼ per cent for 1953. Siemens holders who exchange will not participate in any dividend declared by A.E.I. for 1954, but if the offer is accepted, it is the intention of Siemens, with the concurrence of A.E.I., to pay a 10 per cent dividend for 1954. It is stated that until final results are known it is not clear whether the 1954 dividend could with prudence be maintained at 10 per cent if Siemens continued independently. The directors of Siemens recommend the acceptance of the A.E.I. offer.

A.E.I. proposes to pay quarterly instead of half-yearly dividends. Sir Hugh Warren, a director of Siemens, is managing director of A.E.I., and it is the intention of the latter company to take early steps to increase the permitted number of directors so as to allow the appointment to its board of General Sir William Morgan, chairman of Siemens.

Crabtree Electrical Industries, Ltd.—In the course of his speech at the annual meeting held on 17th December, Dr. H. Schofield (chairman) said that during the year under review there was a gradual acceleration in the rate of demand for all their principal products. The reception given to the new a.c. flush switches which marked their first venture into the "short break" sphere had been gratifying and they were encouraged to extend this range. Over the next twelve months many new products would be appearing, and although some would only replace existing lines, they anticipated that they would be favourably received. Progress so far during the current year was satisfactory.

The British Electric Resistance Co., Ltd.—The annual meeting was held on 17th December. In his circulated statement, Mr. H. Paul-Huhne (chairman and managing director), said that further improvement in trading had been brought about not so much by increased output as by increased efficiency in production, and to lesser extent to the supply and price of raw materials which had moved in their favour during the year. The financial position of the Canadian subsidiary, International Power Transformers, Ltd., had improved to the extent that all outgoings in Canada had been covered and a small profit made, in addition to the profit made by the parent company upon its sales to that subsidiary. Although the present order book was not unsatisfactory, import restrictions were still in operation in certain overseas markets and it would appear that the only practical way to overcome these would be for the company to set up sub-assembly, or even manufacturing plants abroad. It might be advantageous to form a subsidiary company in Australia to serve the south-west Pacific area, and this was receiving serious consideration.

Turner & Newall, Ltd.—The annual meeting will be held on 11th January. In his circulated statement, Mr. W. W. F. Shepherd, after reviewing the activities of the various companies in the group, says that since his statement last year was issued, current earning capacity has not changed significantly in total, but, as was indicated when the interim dividend was announced, experience at home has been better, while that overseas has been less favourable. Demand in the home market remains strong, but overseas difficulties continue without any present indications of a change from buyers' market conditions. The results of the current year's activities will, therefore, as far as can be seen, depend largely on the fortunes of the home companies and should not vary very much from the net figures for the year under review.

The Westinghouse Brake & Signal Co., Ltd., reports a group trading profit for the 53 weeks ended 2nd October last of £1,616,392, as compared with £1,270,787 for the previous year. Taxation absorbs £811,922, and after deducting minority interests of £24,438 and £225,903 retained in subsidiaries, the profit of the parent company is £517,159 (against £249,605). Reserves receive £250,000 and it is proposed to pay a dividend for the period of 18 per cent (against 16 per cent).

Radio Rentals, Ltd., in a preliminary statement, reports profits for the year to 31st August last of £1,600,038, as compared with £1,261,866 for the preceding year, and after meeting all charges, including £313,403 for taxation, the net balance is £249,431 (against £133,019). It is proposed to pay a final ordinary dividend of 30 per cent (unchanged) on larger capital, maintaining the distribution for the year at 40 per cent.

Murex, Ltd., has declared an interim dividend on the ordinary stock of 6 per cent (unchanged).

New Companies

Renouf & Calvert, Ltd.—Registered 10th December. Capital £2,000. To acquire the business of electrical contractors now carried on by H. J. Renouf and K. J. Calvert at 111, Imperial Drive, North Harrow, as Renouf & Calvert. Directors: H. J. Renouf and K. J. Calvert. Regd. office: 111, Imperial Drive, North Harrow.

Universal Electronics (Southport), Ltd.—Registered 13th December. Capital £1,000. Radio, television, telephonic and telegraphic engineers, electrical and electronic engineers, etc. Directors: B. Millington, G. Millington, J. H. Wilson and E. F. Johnson. Regd. office: 84a, Zetland Street, Southport.

Soho Electrical Services, Ltd.—Registered 11th December. Capital £100. Electrical maintenance and installation engineers, etc. The first directors are not named. Regd. office: 6, Soho Street, London, W.1.

Bankruptcies

B. F. Robbings, 1,422, Greenford Road, Greenford Green, Middlesex, lately carrying on business at 1,388, Greenford Road, Greenford Green, under the style of Electric House, radio and electrical retailer, and at 81B, Northolt Road, South Harrow, under the style of Radio and Electric House.—Trustee, Mr. W. J. W. Hill, 58–61, York Terrace, Regent's Park, London, N.W.1, released 15th December.

G. A. Watts and **G. H. Watts,** lately carrying on business under the style of Watts & Watts at 185, Stockwell Road, S.W.9, and 32, Moat Place, Stockwell, S.W.9, electrical engineers (joint estate and separate estate of G. A. Watts).—Last day for receiving proofs for dividend 1st January. Trustee, Mr. A. E. Attwood, 20–21, Lawrence Lane, Cheapside, London, E.C.2.

E. H. Tansey, residing and lately carrying on business at 53, Hollydale Road, Erdington, Birmingham, electrical contractor.—First and final dividend of 6⅝d in the £, payable at the Official Receiver's Office, Somerset House, 37, Temple Street, Birmingham.

R. W. Hembrow, 47, St. Mary's Road, Ealing, London, W.5, electrical engineer.—Receiving order made 14th December on a creditor's petition.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 8th January.

SABA. No. B604,793, Class 9. Radio telephonic and telegraphic apparatus and instruments and parts.—Schwartzwälder Apparate-Bauanstalt August Schever Söhne, Villingen/Schwarzwald, Germany. Address for service, c/o Mathys & Squire, 52, Chancery Lane, London, W.C.2.

TEDDINGTON AUTOMATIC CONTROLS (design). No. B713,488, Class 9. Thermostatic valves; thermostats; magnetic valves and motorized valves, all for controlling the flow of liquids and gases; thermometers; electric switches (ordinary); electrical resistances for testing strains; thermostatic pilot controls for preventing the escape of unburnt fuel from fuel burners; corrugated bellows and diaphragms, all being parts of scientific and electrical apparatus, and electrical apparatus for regulating the heating or cooling of a medium.—British Thermostat Co., Ltd., Teddington Works, Windmill Road, Sunbury-on-Thames, Middx.

MAGIRUS. No. 721,540, Class 9. Electrical apparatus and instruments; telegraphic, telephonic, radio, television, sound recording, receiving, transmitting and amplifying apparatus and instruments; scientific, nautical, surveying, measuring, recording, signalling, life-saving and optical apparatus and instruments; radio aerial masts, breathing apparatus, apparatus for the protection of breathing, etc.—Klockner-Humboldt-Deutz Akt.-Ges., Koln-Deutz, Germany. Address for service, c/o Abel & Imray, Quality House, Quality Court, Chancery Lane, London, W.C.2.

CRISTON. No. 727,452, Class 9. Electrical semi-conducting materials.—Compagnie des Lampes, Paris, France. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

CASTUBES. No. 731,671, Class 9. Electric capacitors (condensers).—Plessey Co., Ltd., 56, Vicarage Lane, Ilford, Essex.

STABILFORMER. No. 733,144, Class 9. Electrical indicating and measuring apparatus and instruments; instruments for checking, testing and verification of instruments; electrical coils being parts of electrical apparatus and machines; electrical induction apparatus; and radio and high frequency apparatus.—B.P.L. (Instruments), Ltd., Houseboat Works, Watling Street, Radlett, Herts.

BESCOL (design). No. 733,663, Class 9. Electric kettles.—Bescol (Electric), Ltd., 118, Parkfield Road, Saltley, Birmingham, 9.

CUECAPS. No. 733,922, Class 9. Electric capacitors (condensers).—A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 2nd February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

5643. Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—Rectifying circuits for supplying high direct voltage. 8th March, 1951. (723208.)

13973. Hofmann, W.—Electric stimulation of respiration. 13th June, 1951. (723213.)

16894. Knight, S. R.—Electric heating device for use in removing paint or the like. 16th July, 1952. (722808.)

17296. Gabor, D., and Hart, T. G.—Electron-discharge devices. 15th July, 1952. Cognate application 29922, 20th December, 1951. (723216.)

19789. British Thomson-Houston Co., Ltd.—Voltage regulators. 4th June, 1952. (723001.)

21052 & 22832. Newbery, Ltd., S., and Newbery, S.—Electrical master timing devices or switches. 2nd and 6th February, 1953. (722902 & 722905.)

23699. Pye, Ltd.—Television pick-up tubes, and television apparatus incorporating same. 9th October, 1952. (722907.)

24607. Telefonaktiebolaget L. M. Ericsson.—Signal transmission systems. 22nd October, 1951. (722813.)

28986. Philips Electrical Industries, Ltd.—Electro-acoustic apparatus for stereophonic reproduction. 11th December, 1951. (723118.)

29008. National Research Development Corporation.—Electrical phase inversion systems. 11th December, 1952. (723119.)

29816. Electric & Musical Industries, Ltd.—Television apparatus, especially television relay apparatus. 8th December, 1952. (723122.) 29817. Television relay apparatus. 8th December, 1952. (723123.)

1952

1. Electric & Musical Industries, Ltd.—Television relay apparatus. 15th December, 1952. Cognate application 10417, 25th April, 1952. (723235.)

600. British Insulated Callender's Cables, Ltd.—Apparatus for testing high frequency electric circuits. 7th January, 1953. (723125.)

6014. Metropolitan-Vickers Electrical Co., Ltd.—Socket holders for plug-in type electrical components. 9th February, 1953. (723026.)

7542. Metropolitan-Vickers Electrical Co., Ltd.—Polymerization products suitable for the insulation of metal articles. 23rd March, 1953. (722829.)

8290. General Electric Co., Ltd., and Gardner, E.—Apparatus responsive to electric signals of the pulse type. 1st April, 1953. (723139.)

8951. Londex, Ltd., and Stern, W. L.—Electric limit switches. 27th March, 1953. (723032.)

9255. Communications Patents, Ltd.—Wired broadcasting systems. 4th May, 1953. (722833.)

9583. Marconi Sounding Device Co., Ltd.—Magneto-strictive transducers. 13th April, 1953. (723140.)

10308. National Research Development Corporation.—Apparatus for arc welding. 31st March, 1953. (723034.)

11439. Philips Electrical Industries, Ltd.—Electric incandescent lamps containing resinous foam. 6th May, 1952. (723141.)

11572. Sorensen Akt.-Ges.—Filament failure devices for electronic tubes. 7th May, 1952. (723253.)

12248. Automatic Telephone & Electric Co., Ltd.—Electrical supervisory control systems. 14th May, 1953. (723038.)

12482. Cable & Wireless, Ltd.—Telegraph transmitting apparatus. 16th July, 1953. (723143.)

13432. British Telecommunications Research, Ltd.—Electrical signalling systems. 21st May, 1953. (723146.) 13433. High-speed storage devices of the magnetic drum type. 21st May, 1953. (723147.) 13435. Telephone or like systems. 21st May, 1953. (723148.)

13534. English Electric Co., Ltd.—Dynamo-electric machines. 22nd May, 1953. (723042.)

14952. British Thomson-Houston Co., Ltd.—Electric discharge devices. 13th June, 1952. (723264.)

15759. British Thomson-Houston Co. Ltd.—Gas-blast electric circuit breakers. 23rd June, 1952. (723156.)

17213.—General Electric Co., Ltd.—Cathode-ray tubes. 6th June, 1953. (723268.)

18019. Electric Furnace Co., Ltd.—High-frequency induction heating. 11th June, 1953. (722846.)

18907. Busch-Jaeger Dürener Metallwerke Akt.-Ges.—Rotary electric switches. 25th July, 1952. (722941.)

19349. Pegurri, G.—Electromagnetic automatically operated safety switch. 31st July, 1952. (723052.)

20365. English Electric Co., Ltd.—Liquid-filled electrical apparatus. 7th August, 1953. (723055.)

20666. Wilkins & Mitchell, Ltd., and Wilkins, E. W.—Washing machines. 17th August, 1953. (723166.)

21648. Research Corporation.—System for energizing electrical precipitators and the like. 28th August, 1952. (723058.)

23397. Simplex Electric Co., Ltd.—Sealing means for the doors or other closure members of ovens and the like. 18th September, 1952. (723277.)

24848. Standard Telephones & Cables, Ltd.—Colour television receivers. 3rd October, 1952. (723174.)

25047. Haley, N. E. J.—Hand tool for stripping insulation from electric conductors. 7th January, 1954. (722856.)

25130. Marconi's Wireless Telegraph Co., Ltd.—Radar display systems. 15th July, 1953. (722858.)

25201. Jansen, B.—Electric power factor correction systems. 8th October, 1952. (723067.)

25312. Philips Electrical Industries, Ltd.—Gas-filled electric discharge valves of the kind comprising a mercury cathode. 9th October, 1952. (723068.)

25560. Willard Storage Battery Co.—Electric storage batteries. 13th October, 1952. (722958.)

25668. Automatic Telephone & Electric Co., Ltd.—Electromagnetic switching devices. 25th September, 1953. (722860.)

25699. Willard Storage Battery Co.—Alloy plate grids for lead acid electric accumulators. 14th October, 1952. (722959.)

25907. General Electric Co., Ltd., and James, E. G.—Methods of preparing single crystals of semi-conducting materials. 30th September, 1953. (723179.)

26619. General Electric Co.—Insulating coatings on conductors. 23rd October, 1952. (723072.)

26661. British Broadcasting Corporation.—Recording of television signals. 11th September, 1953. (722962.)

27639. General Electric Co., Ltd., and Losty, H. H. W.—Electric motor control systems. 3rd November, 1953. (723074.)

28089. Rauland Corporation. — Colour systems for television. 7th November, 1952. (723186.)

28113. Philips Electrical Industries, Ltd.—Apparatus for applying, by vaporization in vacuo, layers of vaporizable substance. 7th November, 1952. (722866.)

29393. Siemens & Halske Akt.-Ges.—Selectors of the telecommunications type. 20th November, 1952. (722974.)

30257. Siemens Bros. & Co., Ltd.—Selective calling systems. 27th November, 1953. (723082.)

30631. Allgaier Werkzeugbau Ges.—Wind-power plant with a centrifugal governor. 3rd December, 1952. (722978.)

30959. Erie Resistor Corporation. — Apparatus for making thin ceramic plates by extrusion. 5th December, 1952. (722981.)

31092. Carr Fastener Co., Ltd.—Electrical plug-in connectors. 20th October, 1953. (723084.)

32874. Collins Radio Co.—Disc holding and frequency measuring fixture. 29th December, 1952. (723198.)

33141. United-Carr Fastener Corporation.—Electrical contact assemblies. 31st December, 1952. (723199.)

1953

2995. Westinghouse Electric International Co.—Dynamic braking control systems for electric driving motors. 3rd February, 1953. (722876.)

3048. Commercial Radio-Sound Corporation.—Audible and visual two-way communication and annunciation system for hospitals and the like. 3rd February, 1953. (722877.)

3244. Green, W. H.—Electric fires. 23rd April, 1953. (722879.)

26613. Sorensen Akt.-Ges.—Voltage regulators incorporating a filament failure device. 7th May, 1952. Divided out of 723253. (723300.)

1954

6648. Shardlow Electric Wires, Ltd., and Jones, P.—Electric plug and socket connectors. 27th February, 1952. Divided out of 722894. (722990.)

Engineering Equipment Users

The Engineering Equipment Users' Association, 20, Grosvenor Gardens, London, S.W.1, was formed in 1949. The general object of the Association is to provide its members with the means of exchanging information on the standardization of engineering materials and equipment which they use in common and, in this way, of presenting their co-ordinated views as users of such materials and equipment. During the five years of its existence, the Association has made progress in the mechanical, electrical and civil fields of engineering, working through the British Standards Institution on all matters of general standardization. It was recently decided to extend the composition of the Association to include associate membership, which entitles those companies who choose this form of membership to obtain benefits technically without the same obligation either in expense or in manpower as full members. The primary qualification of candidates is that they must be predominantly users rather than manufacturers of engineering equipment.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 3rd January, 1955

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Centre. Discussion on "Sandwich Courses," opened by W. H. Taylor. (Joint meeting with the Education Discussion Circle.)

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "Some Design Features of a Semi-Outdoor Power Station at Ince," by F. H. S. Brown.

IPSWICH.—Crown and Anchor Hotel, 6.30 p.m. I.E.E. district meeting. "Design Features of Certain British Power Stations," by S. D. Whetman and A. E. Powell.

MAIDSTONE.—Wig and Gown Hotel, 7.30 p.m. I.E.E. district meeting. "Post Office Cables," by P. Gates.

Tuesday, 4th January, 1955

BIRMINGHAM.—Town Hall, 6 p.m. I.E.E. South Midland Centre. Faraday Lecture: "Courier to Carrier in Communications," by T. B. Terroni.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. "The Co-ordination of Insulation of High-Voltage Electrical Installations," by J. S. Cliff.

LIVERPOOL.—Radiant House, Bold Street, 6.30 p.m. Institution of Heating and Ventilating Engineers, Liverpool and District Branch. "Practical Noise Control in Heating and Ventilating Installations," by E. G. Ewing.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Measurements and Radio Sections. "Equipment of Instrumental Accuracy for Recording and Reproduction of Electrical Signals using Cinematographic Film," by H. McGregor Ross. (Joint meeting.)

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "Development and Utilization of Hydro-Electric Power in Uganda," by J. M. Stock and J. C. Lithgow.

STAFFORD.—At the English Electric Co.'s Lecture Room, Salt Avenue/Sabine Street, 7.15 p.m. I.E.E. North Staffs. Students' Section. Students' Lecture. "Communication of Information—Human, Animal and Machine," by Dr. E. C. Cherry.

Wednesday, 5th January, 1955

BIRMINGHAM.—James Watt Institute, Great Charles Street, 7 p.m. Junior Institution of Engineers, Midland Section. "Power Press Safety," by J. H. Price.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. Association of Mining Electrical and Mechanical Engineers, South Wales Branch. "Electrical Accidents in Coal Mines and their First Aid Treatment," by Dr. T. H. Jenkins.

EDINBURGH.—12, Rothesay Place, 7 p.m. I.E.S. Edinburgh Centre. "Street Lighting Lantern Design," by T. M. Christie.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. "The Economic Selection of Cooling Towers for Generating Stations," by G. F. Kennedy and P. H. Margen and "The Application of Friction-Heat Transfer Correlations to Cooling-Tower Design," by P. H. Margen.

MELKSHAM.—I.E.E. Bristol Students' Section. Visit to Avon Rubber Co., at 7.15 p.m.

MIDDLESBROUGH.—Cleveland Scientific and Technical Institution, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. "Voltage Transformers and Current Transformers associated with Switchgear," by W. Gray and A. Wright.

NEWCASTLE-UPON-TYNE.—Liberal Club, Pilgrim Street, 6.15 p.m. I.E.S. Newcastle Centre. Presidential Address, by E. C. Lennox.

PORTSMOUTH.—College of Technology, 6.30 p.m. I.E.E. Southern Centre. "Aluminium-Sheathed Cables," by P. M. Hollingsworth and P. A. Raine.

SWANSEA.—South Wales Electricity Board, The Kingsway, 6.30 p.m. I.E.S. Swansea Group. Informal meeting. Three papers, followed by a discussion.

Thursday, 6th January, 1955

CARDIFF.—South Wales Electricity Board, The Hayes, 5.45 p.m. I.E.S. Cardiff Centre. "Studies in Interior Lighting." by J. M. Waldram.

CHELMSFORD.—Hoffman's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "A Radio Navigational System for Ships and Aircraft," by C. Powell.

GLASGOW.—39, Elmbank Crescent, 7.30 p.m. I.E.S. Glasgow Centre. "High Bay Lighting," by F. Jones.

LIVERPOOL.—College of Technology, Byrom Street, 7 p.m. British Institution of Radio Engineers, Merseyside Section. "Some Interesting Applications of Electronics to Photography," by D. M. Neale.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. "Problems of Hydro-Electric Design in Mixed Thermal-Hydro-Electric Systems," by T. G. N. Haldane and P. L. Blackstone. (Joint meeting with the Institution of Civil Engineers.)

LOUGHBOROUGH.—The College, 7.15 p.m. I.E.E. East Midland Students' Section. Informal discussion.

MANCHESTER.—College of Technology, Sackville Street, 7 p.m. British Institution of Radio Engineers, North-Western Section. Discussion on "Problems in the Design and Production of Car Radio," opened by C. L. Caiger.

NOTTINGHAM.—E.M.E.B., Smithy Row, 6 p.m. I.E.S. Nottingham Centre. "Recent Studies in Glare," by R. G. Hopkinson and P. Petheridge.

Thursday, 6th January, to Saturday, 8th January, 1955

LONDON. — University College, Gower Street, W.C. Television Society. Annual exhibition.

National Hall, Olympia. National Exhibition of Cage Birds and Aquaria.

Friday, 7th January, 1955

BIRMINGHAM.—Imperial Hotel, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch. "Gas Turbines in Industry," by J. R. Needham.

BRISTOL.—Royal Hotel, 6.15 p.m. I.E.S. Bath and Bristol Centre. "Studies in Interior Lighting," by J. M. Waldram.

NEWCASTLE-UPON-TYNE. — Grand Hotel, Barras Bridge. I.E.E. North-Eastern Students' Section, Tyneside meeting. Problems night, led by the Centre chairman.

EAST AFRICAN IMPORTS

THE official statistics of East African trade in 1953 reflect that country's big purchases of power plant. There was an increase in value of about one-third. Of the three territories Kenya was the most important buyer with nearly half the total and Uganda came next with one third. Kenya was also a large buyer of telegraph and telephone material. Decreases were experienced by lamps, radio receiving sets for the home, and cables and wires except to Uganda. The predominant position of the United Kingdom in the electrical trade generally was well maintained.

Class of Equipment	Kenya		Uganda		Tanganyika	
	1953 £ (000)	Inc. or dec. on 1952 £ (000)	1953 £ (000)	Inc. or dec. on 1952 £ (000)	1953 £ (000)	Inc. or dec. on 1952 £ (000)
Generators, motors, convertors and transformers	743*	+ 171	567*	+ 302	329*	+ 110
Batteries and accumulators for motor vehicles	82*	— 25	44*	+ 8	30*	— 59
Lamp and torch batteries	42	+ 4	17	+ 9	29	+ 6
From Malaya	29	+ 5	10	+ 5	21	+ 5
,, *South Africa*	8	— 1	4	+ 3	5	+ 2
Other batteries and accumulators	52	+ 13	8	+ 3	18	—
From U.K.	22	+ 4	7	+ 4	8	—
,, *South Africa*	6	+ 2	—	—	4	+ 2
,, *France*	17	+ 6	—	—	1	— 4
Bulbs and tubes for lighting, domestic	25	— 21	10	+ 1	8	— 16
From U.K.	16	— 14	7	+ 1	6	— 9
,, *Netherlands*	9	— 6	3	—	1	— 7
Bulbs and tubes, other	22	+ 5	7	—	4	— 6
From U.K.	10	—	5	+ 5	3	— 3
,, *Netherlands*	10	+ 10	1	— 1	1	— 1
Radio receiving sets, domestic	112	— 12	27	— 38	54	— 19
From U.K.	64	—	16	— 13	33	— 8
,, *Netherlands*	33	— 23	8	— 24	20	— 8
,, *West Germany*	6	+ 6	2	+ 2	1	+ 1
Radio receiving sets, other, and spares	178	+ 119	29	— 1	25	+ 1
From U.K.	168	+ 118	27	+ 26	22	—
Insulated cables and wires	439	— 527	298	+ 168	158	— 141
From U.K.	411	— 451	297	+ 172	131	— 128
,, *South Africa*	2	—	—	—	17	+ 16
Telegraph and telephone instruments and apparatus	485*	+ 274	15*	+ 9	90*	+ 22
Portable tools and appliances and small domestic devices not over 15 kg	54	— 17	13	— 4	15	— 21
From U.K.	46	— 24	11	— 5	14	+ 14
,, *West Germany*	5	+ 5	1	+ 1	—	—
Elec. appliances for motor vehicles, etc.	31	— 75	56	— 7	13	— 42
From U.K.	19	— 40	51	—	11	— 35
,, *Netherlands*	4	+ 4	3	+ 2	1	+ 1
,, *U.S.A.*	4	— 5	1	—	—	—
Torches complete or excluding batteries and bulbs	12	— 5	7	— 1	10	— 4
From Hongkong	12	—	5	— 1	7	— 4
Other appliances and apparatus	232*	— 23	146*	+ 14	90*	— 64
Parts and accessories, unspecified	27*	— 153	26*	— 105	39*	— 15

* Mainly from U.K.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Belfast.—3rd February. Electricity Department. Two electric cranes. (See this issue.)

Bolton.—15th January. Corporation. Street lighting equipment. (See this issue.)

Bootle.—8th January. Borough Council. Electric cables and electrical goods (Form 14) and electric lamps (Form 15) for one year. Borough surveyor, Town Hall.

Canada.—10th January. City of Winnipeg Hydro-Electric System. 5 kV double throw circuit breaker. (E.S.B. 28885/54. Ten/11873.)* Nine 69 kV circuit breakers. (E.S.B. 28884/54. Ten/11872.)*

Dundee.—North of Scotland Hydro-Electric Board. Multi-core h.v. and l.v. cables. (See this issue.)

Gainsborough.—4th January. U.D.C. Submersible pumping set, with electrical equipment, for Lea Road Waterworks. Surveyor, Council Offices, 6, Lord Street.

Greece.—24th January. Public Works Branch, Greek Air Force General Staff, Athens. Electrical distribution system for Souda Bay airfield. (E.S.B. 19477/54. Ten/10703A.)*

India.—16th January. Government of Mysore Stores Purchase Committee, Bangalore. Electrical machinery for Government electrical factory. (E.S.B. 29308/54. Ten/11902.)*

Iraq.—5th January. Directorate General of Municipalities, Bagdad. 100 kW d.c. generating set. (E.S.B. 29375/54. Ten/11886.)* 31st January. 100 kW a.c. generating set. (E.S.B. 29320/54. Ten/11876.)* 100 kW alternator set. (E.S.B. 29374/54. Ten/11887.)* 7th February. 200 kW d.c. generating set. (E.S.B. 29376/54. Ten/11885.)* 9th February. 200 kW d.c. generating set. (E.S.B. 29377/54. Ten/11890.)* 12th February. One 100 kW and one 150 kW d.c. generating sets. (E.S.B. 29379/54. Ten/11888.)* One 50 kW and one 100 kW d.c. generating sets. (E.S.B. 29378/54. Ten/11889.)* 14th February. 150 kW d.c. generating set. (E.S.B. 29319/54. Ten/11876.)* Two 50 kW d.c. generating sets. (E.S.B. 29318/54. Ten/11877.)* 15th February. 100 kW d.c. generating set. (E.S.B. 29371/54. Ten/11878.)*

London.—7th January. Camberwell Borough Council. Electrical fittings, cables and conduits for one year. Borough engineer, Town Hall, S.E.5.

3rd January. Finsbury Borough Council. Electric lamps for one year. Borough engineer, Finsbury Town Hall Annexe, Rosebery Avenue, E.C.1.

Marlborough and Malmesbury.—17th January. R.D.C. Two sets of electrically driven sewage pumps, with equipment, for Aldbourne Drainage, Contract No. 1. John Taylor and Sons, engineers, Artillery House, Artillery Row, Victoria Street, London, S.W.1.

Newbury.—17th January. Corporation. Street lighting equipment. (See this issue.)

New Zealand.—10th February. Stores Division, G.P.O., Wellington. Electric radiators. (E.S.B. 29406/54. Ten/11894.)*

Prestwich.—29th January. Borough Council. Electric lamps (Form 13) and electrical equipment (Form 14) for one year. Borough engineer, Town Hall.

South Africa.—13th January. Union Tender and Supplies Board, Pretoria. Radio valves. (E.S.B. 29420/54. Ten/11900.)* 20th January. Recording thermo-electrical apparatus and tyschrometer. (E.S.B. 29452/54. Ten/11911.)*

Southampton.—10th January. Electrical work in shops, flats and maisonnettes. (See this issue.)

Tangier.—24th February. Tangier Water and Electricity Board. Installation of street lighting. (E.S.B. 29289/54. Ten/11880.)*

United States.—13th January. Bureau of Reclamation, Denver, Colorado. One 5,000 kVA transformer. (E.S.B. 29153/54. Ten/11851.)*

ORDERS PLACED

Bradford.—City Council. Electrical installations in 64 flats on the Buttershaw estate (£2,763).—J. Carter & Sons (Bradford).

Croydon.—Electrical installation at St. Mary's Secondary Modern School, West Croydon (£3,956).—A. Tindall & Sons.

Ilford.—Borough Council Housing Committee. Re-wiring of houses on the pre-war Ley Street estate (£2,061).—B. Winters & Son.

London.—L.C.C. Pumping plant, including power factor correction equipment, at Abbey Road site, Woolwich (£30,029).—Gwynnes Pumps.

Southgate.—U.D.C. Installation of road lighting (£7,327).—Cohen Bros. (Electrical).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Addington.—Factory, Vulcan Way; A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garrett Lane, London, S.W.18.

Barking.—Thames View County Infants' School (£64,000) for E.C.; borough architect, Town Hall.

Beckenham.—Drill hall and garages for Kent T.A. Association; John F. Kennedy, architect, 63, Wigmore Street, London, W.1.

Birkenhead.—Houses (258), at Woodchurch; borough architect, Wexford Road.

Durham.—Erection of secondary modern school at Bowburn for the C.C. (£57,000); Hills, Ltd., builders, West Bromwich.

Secondary modern school at Billingham for the C.C. (£57,000); Hills, Ltd., contractors, West Bromwich.

Children's home at Washington for the C.C.; direct labour by Washington U.D.C.

Ely and Wisbech.—High school and college of further education; H. A. Sandford, electrical consultant, 2, Gate Street, London, W.C.2.

Hatfield.—Factory, New Town industrial estate; Die Casting Machine Tools, Ltd., Stuart House, River Park Road, London, N.22.

Herts.—Secondary modern school at Cold Harbour, Bushey (£160,047), and extensions to county grammar school, Cheshunt (£52,425) for E.C.; county architect, County Hall, Hertford.

Leicester.—Shops with maisonnettes over, on Nether Hall estate (£86,200); city architect.

Liverpool.—Dwellings (66), Mather Avenue; city architect.

Office block, Hatton Garden; Peak Construction Co., Ltd., 49, Hamilton Square, Birkenhead.

Loughborough.—New outpatients' department for Sheffield Regional Hospital Board at Loughborough Hospital; H. Mounteney & Son, Ltd., Loughborough.

Maidenhead.—Houses (44), on Spencers estate; borough surveyor, 14, Craufurd Rise.

Maidstone.—Garage, offices, store premises, etc., in London Road for Drake & Fletcher, Ltd., agricultural, motor and electrical engineers, The Broadway; C. Worthington, architect, St. Annes, Boxley Road.

Middlesbrough.—Proposed St. Anthony's R.C. Secondary Modern School; education architect, Education Offices.

Newcastle-on-Tyne. — Ophthalmic outpatients' department at Newcastle General Hospital (£24,000); J. M. Black, Ltd., builders, Glen Street, Hebburn.

Newton Abbot.—Large factory; Centrax Power Units, Ltd., turbine engineers, 83, High Sreet, Brentford.

Northampton.—275 houses; E. J. Cave, borough surveyor, Guildhall.

North Riding.—New primary school at Eastfield, Scarborough, for the C.C. (£44,000); Schofield, Ltd., builders, Hornsea, Yorks.

Penrith.—Houses (76), on Scaws estate; C. H. Huntley, clerk, Town Hall.

Peterborough.—New girls' secondary modern school on Dogsthorpe North estate (£140,000); city engineer, Bridge Street.

Scarborough.—Houses (66) and doctor's surgery on the Eastfield estate for the T.C.; E. Hunter, Ltd., builders, Beaconsfield Street.

Sedgefield.—Houses (400); J. Tarran, surveyor, R.D.C.

Skegness.—Hall for conferences, etc. (£200,000); surveyor, Urban Council Offices.

Southampton.—Departmental store, Houndwell Place; Edwin Jones & Co., Ltd., East Street.

Spalding.—Girls' high school in Stonegate for Holland County Council; county architect, Boston.

Stainforth.—New Roman Catholic Church, with electric heating in floor; H. A. Hickson & Son, Hallgate, Doncaster.

Stockport.—Houses (104), together with children's home, Brinnington estate; W. F. Gardner, borough surveyor, Town Hall.

Sunderland.—R.C. church and presbytery, Ryhope Road; S. W. Milburn and Partners, architects, 9, Esplanade, Sunderland.

Swindon.—Factory, Moredon industrial estate; Clover Leaf Products, Ltd., 1, Mercy Terrace, London, S.E.13.

Thornaby-on-Tees.—Dwellings (86), Gilpin Brown estate; borough architect.

Twickenham.—Flats (48), Broad Lane, Hampton; borough engineer.

Upminster. — Crematorium buildings (£50,000), Ockendon Road for South Essex Crematorium Joint Committee; P. L. Cox, acting clerk, Council Offices, Hornchurch.

West Bromwich.—Warehouse and offices, Pleasant Street; R. Rogers & Co., Ltd., Angelina Street, Birmingham, 12.

Works extensions; Electromobile Engineering Co. (West Bromwich), Ltd., 402, High Street.

West Sussex.—Schools at Horsham (£164,900) and Littlehampton (£165,830); F. R. Steele, county architect, County Hall, Chichester.

Weston-super-Mare.—Houses (40), on Coronation estate; R. G. Lickfold, town clerk, Town Hall.

Winchester.—Offices, Royal Hampshire Hospital; R. F. M. Mellor, architect, 76, Wimpole Street, London, W.1.

Worthing.—Three-storey offices, 60/62, Chapel Road; Pearl Assurance Co., Ltd., High Holborn, London, W.C.1.

Yeovil.—Dwellings (110), Sunningdale estate; borough surveyor.

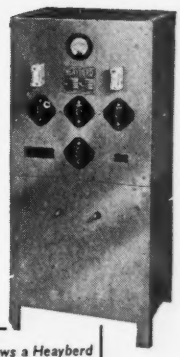
* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

BATTERY CHARGERS

HEAYBERD BATTERY CHARGERS, incorporating metal rectifiers, embody the results of more than 25 years' experimental work and the understanding of customers' special requirements.

No matter how large or small, we shall be glad to quote for Battery Chargers made to suit your own particular purpose.

List No. 1048 describing over thirty different types of Battery Chargers is obtainable on request.



The photograph shows a Heayberd Model 6716 Battery Charger for charging from 3 to 36 cells at two to sixteen amps.

HEAYBERD

F. C. HEAYBERD & CO. LTD Head Office: GREENWICH SOUTH STREET, S.E.10.
Phone: TIDeway 4646 (3 lines)
Works: Greenwich. Cables & Grams: "Heayberd, Green, London"

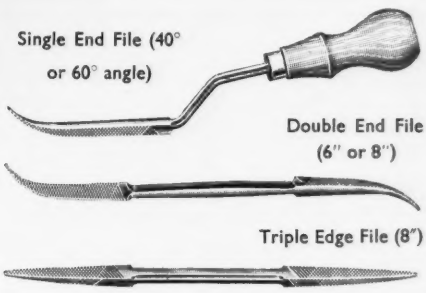
MARTINDALE

MICA UNDERCUTTING *System No. 1*

By the use of shaped files used either

BY HAND

or in **POWER TOOLS**



Single End File (40° or 60° angle)

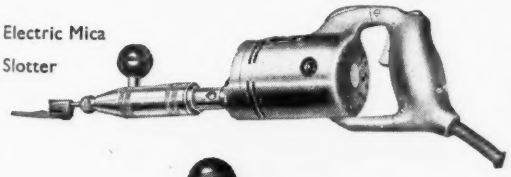
Double End File (6" or 8")

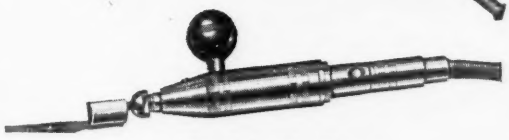
Triple Edge File (8")

Jiff-V File

Jiff-V "U" Cutter

Electric Mica Slotter



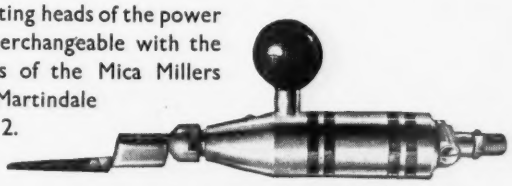


Flex-Drive Mica Slotter

With these files and power tools, mica undercutting is a quick and simple process and slots may be cut right up to the risers.

The tools are so shaped that slots can usually be cut by working through the ventilating or other openings in the motor or generator frame, without the need for removing brush arms.

The oscillating heads of the power tools are interchangeable with the milling heads of the Mica Millers used in the Martindale System No. 2.



Pneumatic Mica Slotter

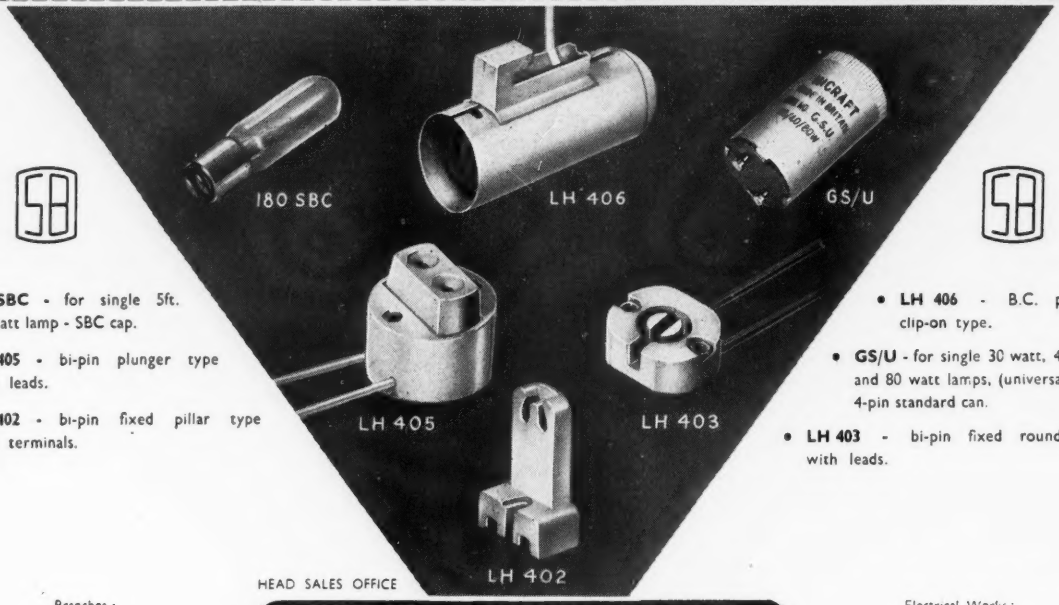
Write for details of other Martindale Undercutters, Fault Finders, Commstones, etc.

also at
25 Elmbank Street, Glasgow, C.2

MARTINDALE ELECTRIC CO. LTD.
4 WESTMORLAND ROAD, LONDON, N.W.9

E

FLUORESCENT LAMP ACCESSORIES



- **180 SBC** - for single 5ft. 80 watt lamp - SBC cap.
- **LH 405** - bi-pin plunger type with leads.
- **LH 402** - bi-pin fixed pillar type with terminals.
- **LH 406** - B.C. plunger clip-on type.
- **GS/U** - for single 30 watt, 40 watt and 80 watt lamps, (universal) 2 or 4-pin standard can.
- **LH 403** - bi-pin fixed round type with leads.

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Telephone: Whitehall 8267.

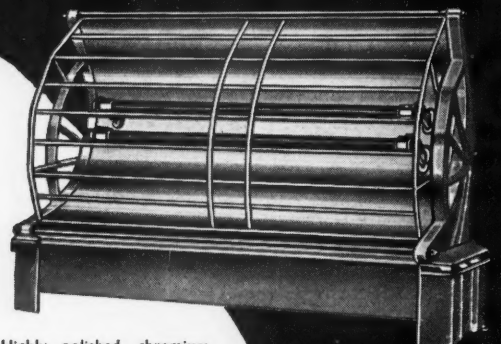
Branches: Manchester, Birmingham, Leeds and Bristol.

Export Office: 105 Judd Street, London, W.C.1.

Electrical Works: Trading Estate, Spennymoor, Co. Durham. Telephone: Spennymoor 2273

IAG4

THE *Crossland* RAYDANT ELECTRIC FIRE



Highly polished chromium plated reflector and approved guard. Robust construction. Generous dimensions 17" wide, 11½" high, 6" deep. Excellent finish stoved cream enamel. Approved by Electricity Boards.

LIST PRICES

Model No. 800/1 One kW Fire
£2.7.6 P.T. 17/2

Model No. 800/2 Two kW Fire
£3.4.2 P.T. £1.3.2
Range 200/220v 230/250v

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Compliance with British Standard Specifications is the

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of a good cable. Still higher standards ensuring greater durability are the

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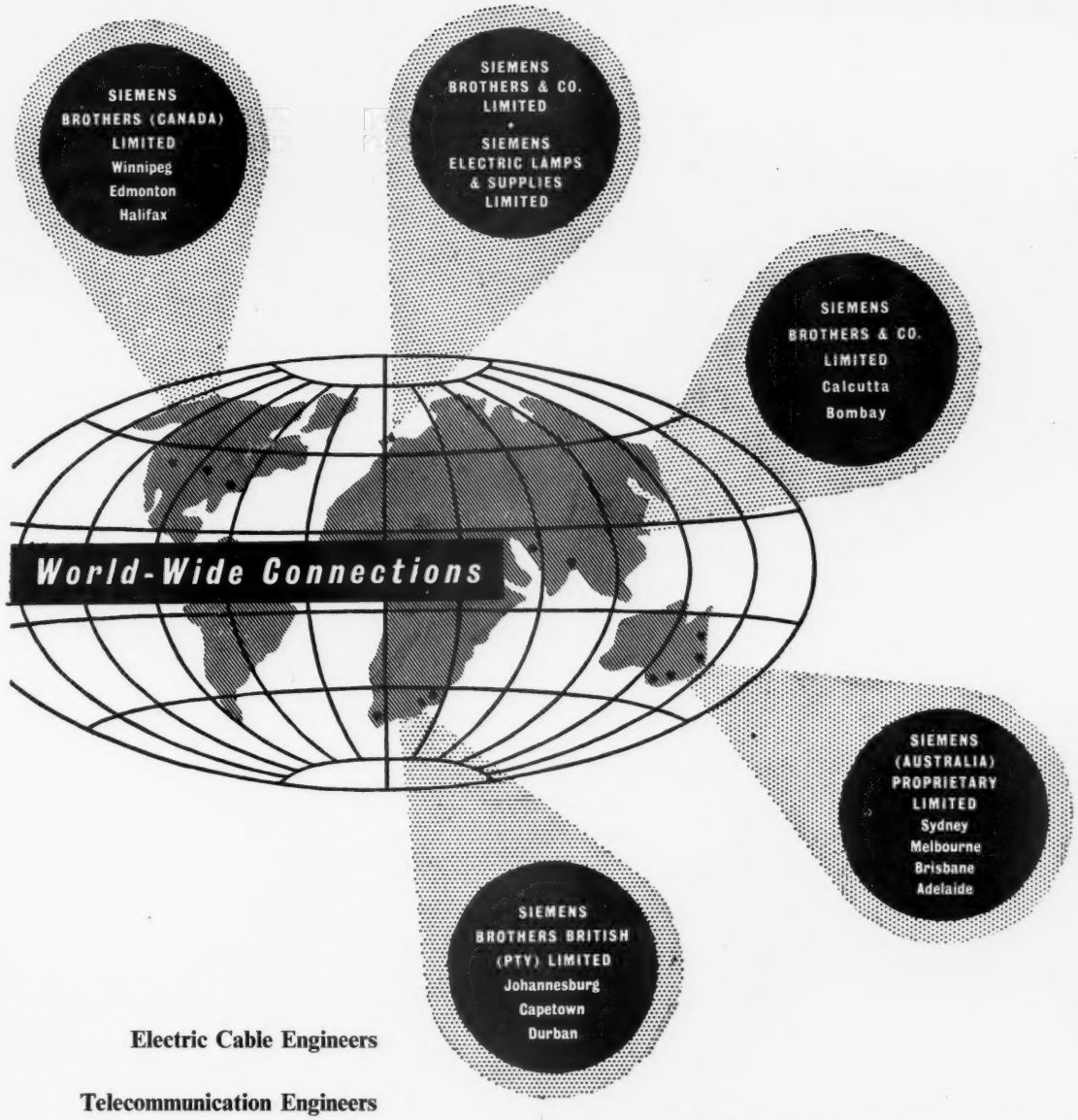

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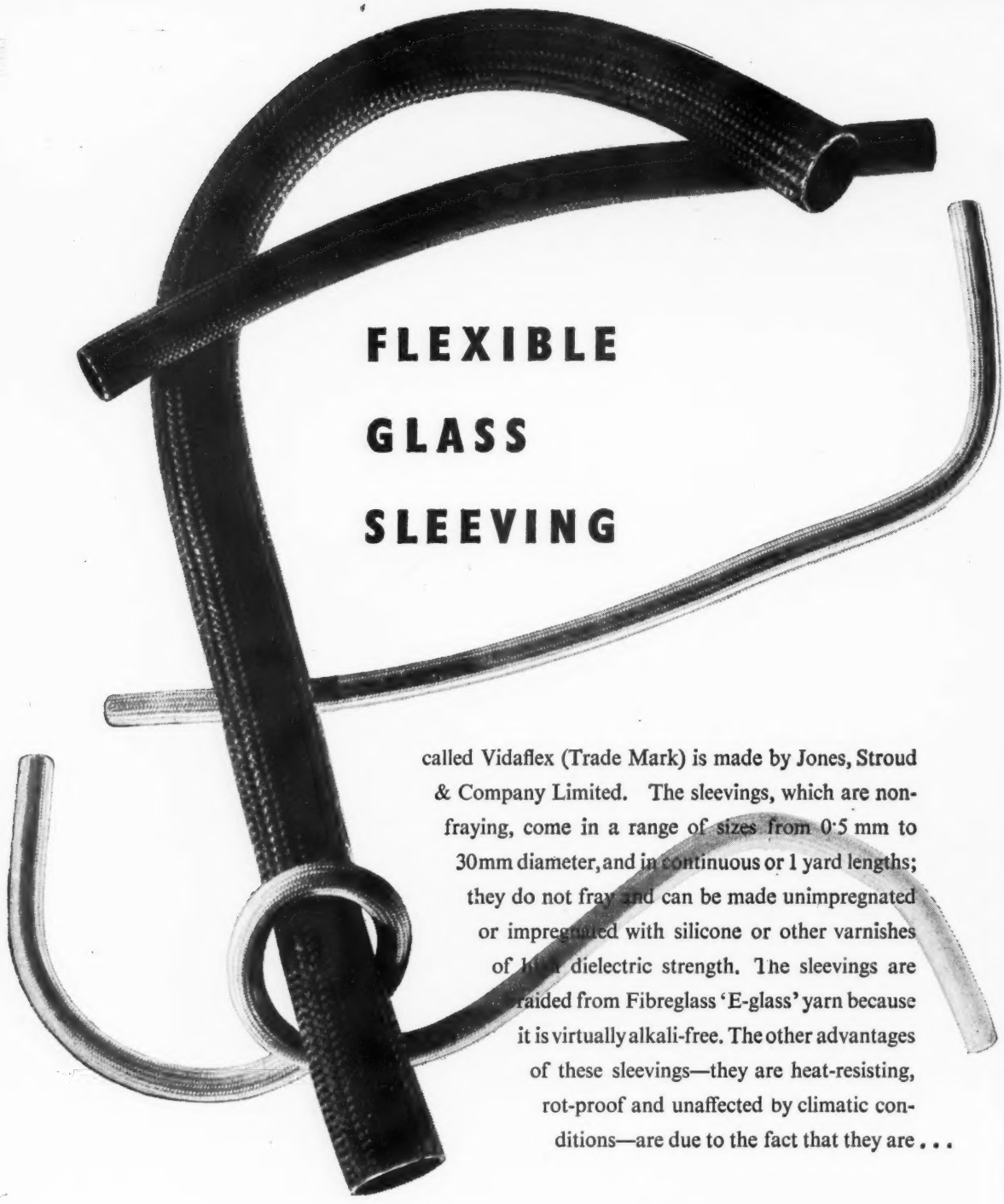
Throughout the physical world there are few countries in which the Siemens Brothers organisation is not represented and fewer still in which it has not undertaken important contracts. Public telephone exchanges and private telephone installations; underground and underwater telecommunication cables; power cables for electrical transmission and distribution — all these bear daily witness in all parts of the world to the efficiency and leadership of Siemens Brothers.

From the Preston works come Tungsten Filament Lamps of all types, Sieray Electric Discharge Lamps, Fluorescent Tubes, Sodium and Mercury Lamps and equipment for every lighting purpose. From other factories come cables of all types and sizes, a wide range of telecommunications equipment, marine apparatus and other electrical products. The quality of these has for nearly a century made the name of Siemens Brothers synonymous with satisfaction throughout the world.

Works at Woolwich; Preston; West Hartlepool; Spennymoor; Halifax



FLEXIBLE GLASS SLEEVING

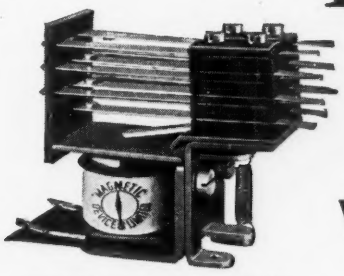
called Vidaflex (Trade Mark) is made by Jones, Stroud & Company Limited. The sleevings, which are non-fraying, come in a range of sizes from 0·5 mm to 30mm diameter, and in continuous or 1 yard lengths; they do not fray and can be made unimpregnated or impregnated with silicone or other varnishes of high dielectric strength. The sleevings are braided from Fibreglass 'E-glass' yarn because it is virtually alkali-free. The other advantages of these sleevings—they are heat-resisting, rot-proof and unaffected by climatic conditions—are due to the fact that they are . . .

. . . braided from FIBREGLASS TRADE MARK

FIBREGLASS LIMITED, Ravenhead, St. Helens, Lancs *(St. Helens 4224)*

Factories at St. Helens, Lancs and Possilpark, Glasgow

RELAYS



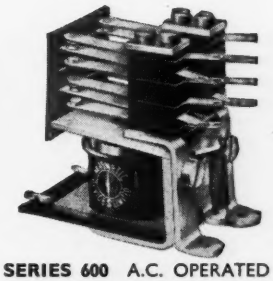
SERIES 100 A.C. OPERATED
SERIES 105 D.C. OPERATED

An extremely sturdy general purpose relay, which is available in a range of contact combinations from 1 pole normally open to 4 pole changeover, and 6 pole normally open, with a maximum contact rating of 10 amps 250v A.C. Normal power consumption is 3 watts, which can be reduced for the smaller contact assemblies if required. Vacuum impregnated coils can be supplied for tropical or humid conditions.

TWO GENERAL PURPOSE TYPES WITH LIGHT DUTY CONTACT RATING

PHONE:
NEWMARKET 3181-2-3

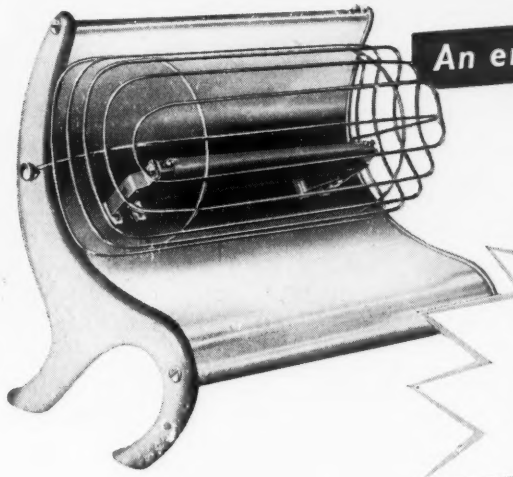
TELEGRAMS:
MAGNETIC NEWMARKET



SERIES 600 A.C. OPERATED
SERIES 605 D.C. OPERATED

This relay is similar to the Series 100/105 and has been specifically designed for light duty applications. Featuring sturdy and extremely compact blade assemblies from 1 pole normally open to 4 pole changeover, and 6 pole normally open. The contacts will carry 5 amps at 250v D.C. Following the usual practice all contact connections are conveniently grouped at one end, and coils can be wound for either current or voltage operation to requirement. Vacuum impregnated coils if specified.

MAGNETIC DEVICES LTD
NEWMARKET



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RADIANT ELECTRIC FIRE

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- 5 attractive colours
- Light in weight
- In accordance with BSS1670

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	1 kW.	2 kW.
Maximum Loading		
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CARRON *Electric Fires*

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E45

an ever-increasing number of companies are solving their

SMALL GENERATION AND CONVERSION PROBLEMS

with standard or specially designed machines by

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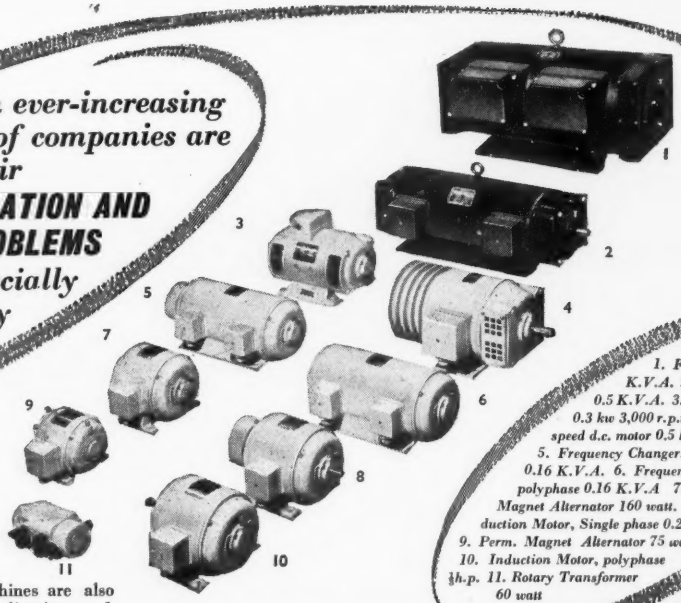

1. Frequency Changer 2 K.V.A. 2. Frequency Changer 0.5 K.V.A. 3. Rotary Transformer 0.3 kw 3,000 r.p.m. 4. Governed speed d.c. motor 0.5 h.p. 5. Frequency Changer, single phase 0.16 K.V.A. 6. Frequency Changer, polyphase 0.16 K.V.A 7. Perm. Magnet Alternator 160 watt. 8. Induction Motor, Single phase 0.2 h.p. 9. Perm. Magnet Alternator 75 watt 10. Induction Motor, polyphase ⅓h.p. 11. Rotary Transformer 60 watt

These exceptionally well-built machines from the standard range are designed for 24-hours-per-day, trouble-free operation, and are solving the small generation and conversion problems of many companies in a wide range of applications. Specially-designed Walter Jones machines are also giving valuable service for unusual applications and requirements. Your enquiries—simple or complicated—would receive our immediate attention.

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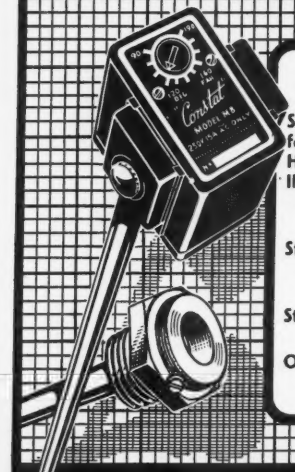

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STEM TYPE THERMOSTAT for control of IMMERSION HEATERS, PLATENS, DRYING OVENS, Etc.

Suitable for 15 amps, 250 V. A.C. only.

Standard Instrument 11" stem with ½" B.S.P. pocket.

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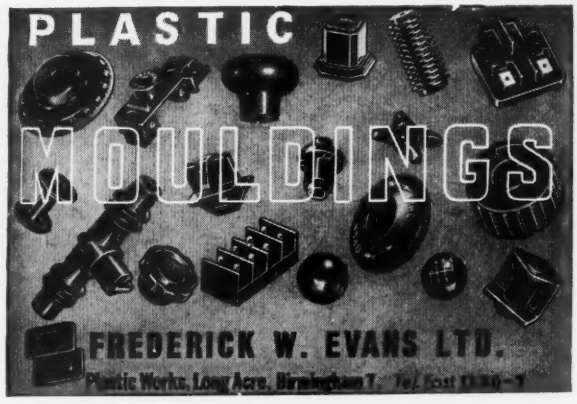

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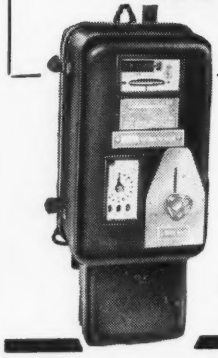

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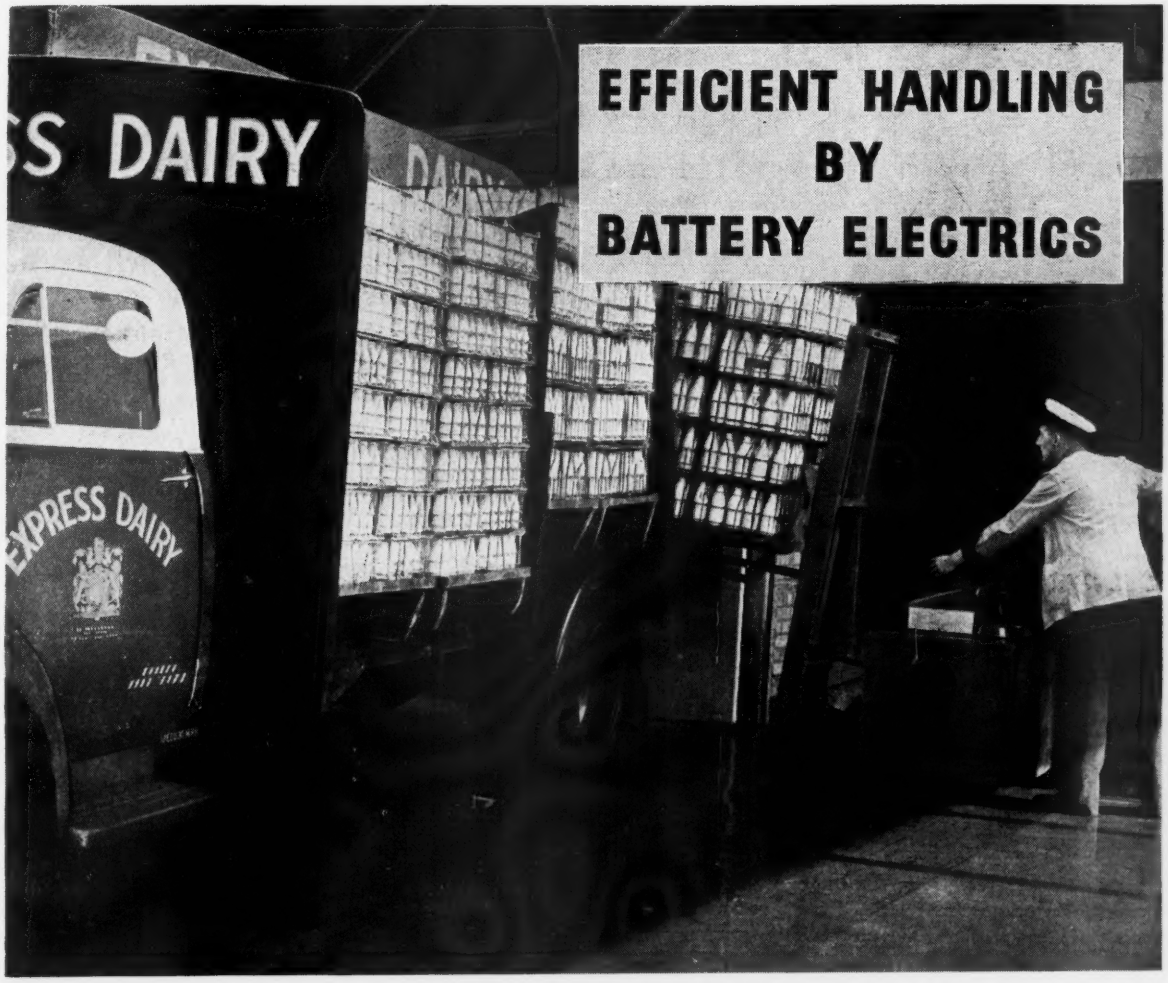

Photograph by courtesy of Messrs. Lansing Bagnall Ltd.

When the battery of this Lansing Bagnall forklift truck has discharged its battery, the operator plugs into the nearest available power point and the battery is recharged by the 'WESTALITE' rectifier incorporated in the charger built into the truck.

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DOUBLE-VOLTAGE WESTALITE RECTIFIERS *for* **BATTERY ELECTRIC TRUCKS**

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"It's all works and no space!"

said the Works Manager

HE didn't look good at all. All the marks of a long spell of strain. "For months I've been doing the impossible", he bawled, as we threaded our way through the factory. "And because I did it last time they think I can do it again. Not a square inch of floor space, and now *I'm told to find room for a test bench . . ." We stopped him before he exploded. Gently we told him his worries were at an end. We were from Yale. We'd been called in by the management to plan a new scheme for materials handling.*

"Materials handling? . . . that's what I told them six months ago! Clear at least three aisles and we could stack to the end bay northlight . . . Well, well.

Here, let me show you the annexe . . ."

He moved like a different man. He had ideas. We had ideas. Together we plotted a scheme that gave him just what he wanted. And, not surprisingly, we pleased the management too — when they saw the turn their costs would take.

IS LACK OF SPACE RESTRICTING YOUR OUTPUT?

Yale's versatile

"WORKSAVER"

is specially suitable for smaller plants

AMONG the wide range of Yale handling equipment the "Worksaver" series of trucks is of special interest to factories where restricted space or low-load floors have previously made mechanical handling impractical. Its small size, light weight and extreme ruggedness give big-truck advantages with small-truck economy and convenience.

It will lift, move and stack raw materials or finished products. It saves time, space and manpower. You can ride it or walk it. And it will start cutting costs from the minute you put it to work.

The "Worksaver" is available in five basic types: pallet, low-lift platform, high-lift platform, fork-lift and tractor.

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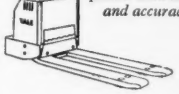
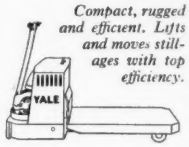
Built to stand up to rugged jobs. Lifts and moves maximum load pallets with ease and accuracy.



PLATFORM

Compact, rugged and efficient. Lifts and moves stillages with top efficiency.



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A powerful and manœuvrable tractor unit to pull trailers or trailer trains with up to 700 lbs. drawbar pull.

FORK LIFT *Lifts, moves and stacks over low-load floors: saves time, space and manpower wherever it's put to work.*

YOU GET ALL THESE ADVANTAGES WITH THE "WORKSAVER"

- ✱ *Manœuvrable in small spaces and narrow aisles.*
- ✱ *Light weight with great strength and power permit heavy duty work on low-load floors.*
- ✱ *Dead man control cuts power and applies brakes automatically in emergency.*
- ✱ *Simple fingertip controls—unskilled staff can move, lift and stack with speed and safety.*
- ✱ *Low initial cost, low running cost, economical maintenance, long life.*

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MADE IN ENGLAND BY

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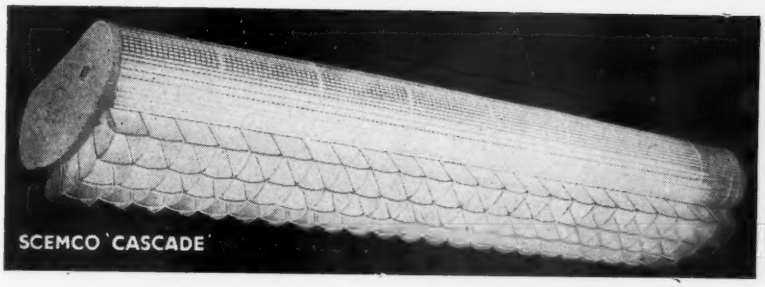

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OR

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(All Plastic Diffuser) FITTING

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TWIN LAMP 4 ft. 40 watt	£14.14.0 list
TWIN LAMP 2 ft. 40 watt	£10.17.6 list
TWIN LAMP 2 ft. 20 watt	£10.10.0 list

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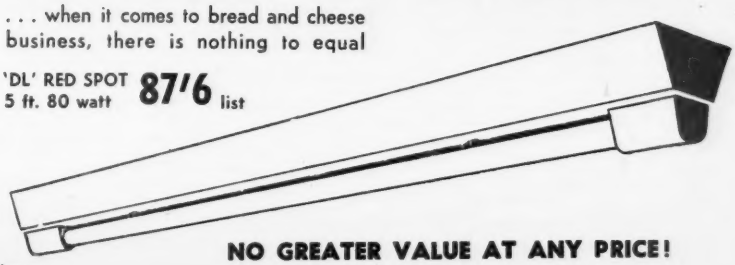

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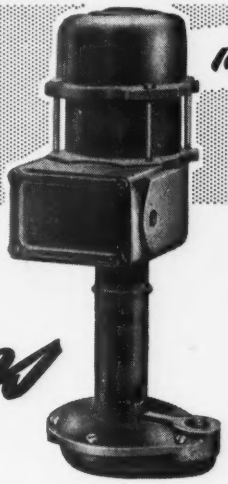
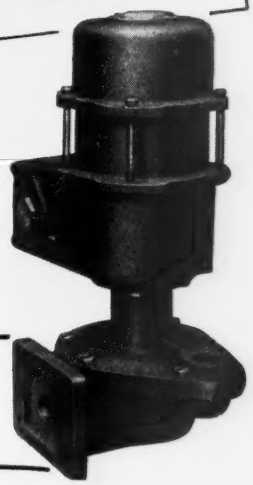


IMMERSED TYPE

IMMERSED TYPE WITH SWITCH

'T' TYPE FOR EXTERNAL MOUNTING



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"MINIM" 3 GALLONS PER MINUTE AT 6ft. HEAD.
"MINOR" 8 GALLONS PER MINUTE AT 10ft. HEAD.
"MAJOR" 25 GALLONS PER MINUTE AT 12ft. HEAD.

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MANUFACTURING ELECTRICAL AND MECHANICAL ENGINEERS

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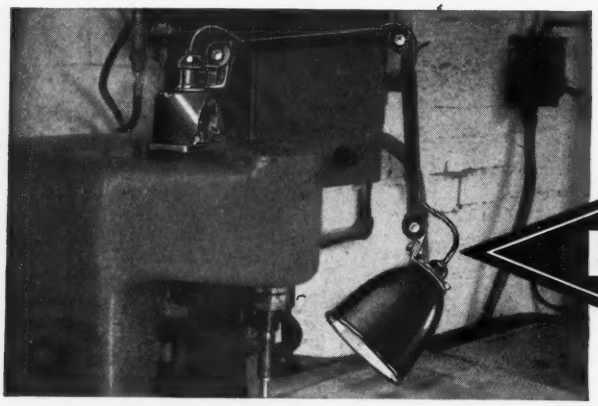

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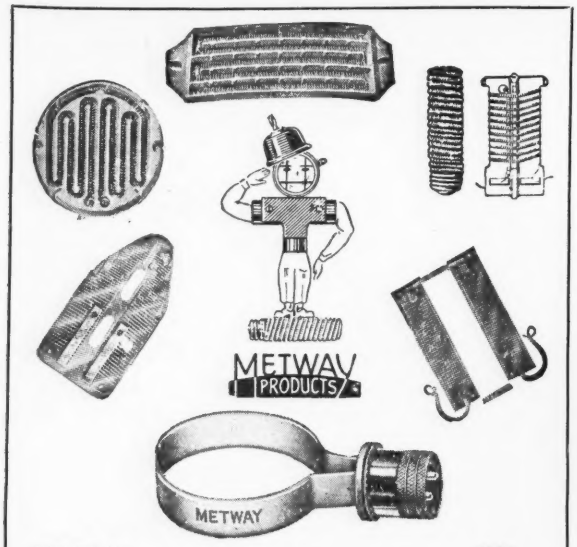

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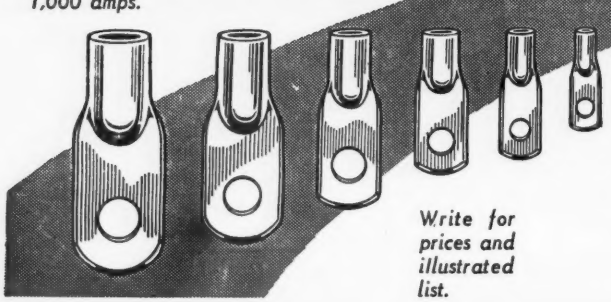
Tapes stator and armature coils, quickly and neatly. This machine is fitted with finely adjustable taping tension and quickly tapes light or heavy coils with equal perfection.
A necessity for repairs or production, and an ideal companion to a "QUICKWAY" Coil Winding and Forming Machine.
We offer delivery from stock for Bench Mounting, complete with Foot Operated Clutch Unit and Motor.
Full details and information will be supplied on request.

The MIDLAND DYNAMO CO. Ltd.

64 BELGRAVE GATE, LEICESTER
Telephone 20172 (5 lines) Grams: "DYNAMO"

COLD METAL PRESSINGS MANUFACTURERS

1,000 amps.



Write for prices and illustrated list.

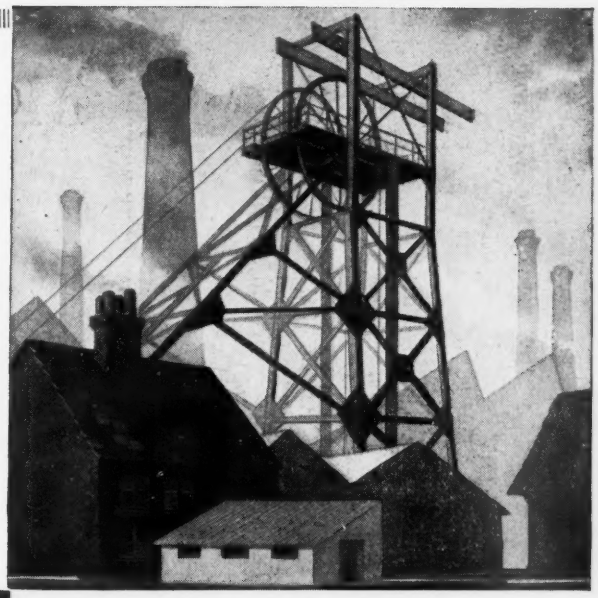
COPPER TUBULAR
CABLE SOCKETS

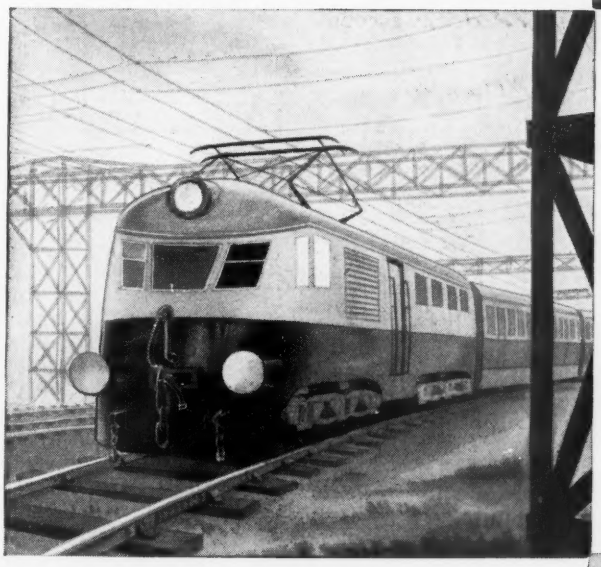
15 amps. DIPPED TINNED
B.E.S.A. Type X.L. Light Type

EXCELALL
METAL WORKERS LTD.

Phone: Victoria 0297 BIRMINGHAM 11 Grams: "Superpress"

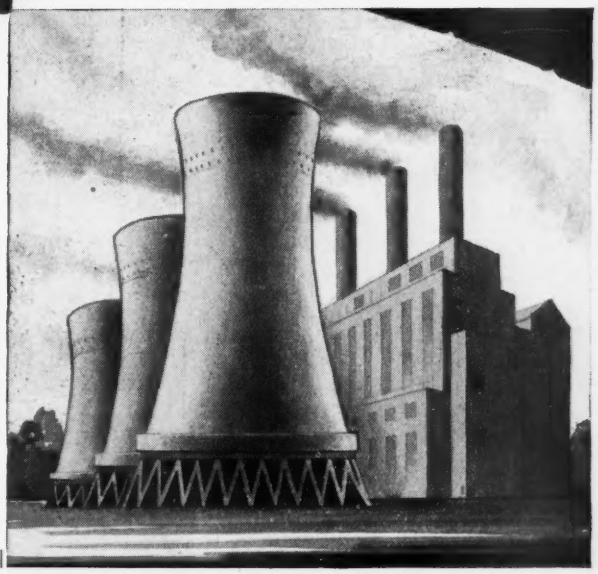
Current problems solved!





Behind the solution to "current" problems stand fifty-eight years of research and practical application in the field of cable construction. Well known to engineers for their superb performance and reliability, CONNOLLYS Paper Insulated Power Cables have "grown-up" with the mighty giant of Electric Power. Many Area Electricity Boards, Collieries and Railways rely on the safe enduring qualities of CONNOLLYS Cables knowing that in our modern factory we, ourselves, carry through every stage of manufacture from wire-drawing, to final testing. CONNOLLYS Paper Insulated Power Cables are produced to British Standards and other specifications from 660 to 11,000 volts. Special finishes can be manufactured to customers own requirements.

Founder members of the C.M.A.



CONNOLLYS
(BLACKLEY) LIMITED

HEAD OFFICE: MANCHESTER 9

'Phone:
CHEetham Hill 1801

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23, Starcross Street,
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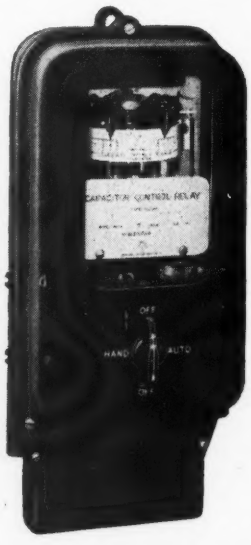
Transva kVA Demand Meter (with or without alarm contact).

Types MASA and MASI Relays. For the limitation of kVA demand.

MODERN TARIFFS require modern methods of LOAD CONTROL

Metrovick equipment for power-factor control and M.D. limitation has been designed by specialist engineers and is fully up-to-date. It can make possible substantial savings in your electricity account.

Please write for descriptive leaflets.



Type NJO4 Relay for the Automatic Control of the Single-stage Capacitors used for power-factor improvement.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

Member of the AEI group of companies

Leading Electrical Progress

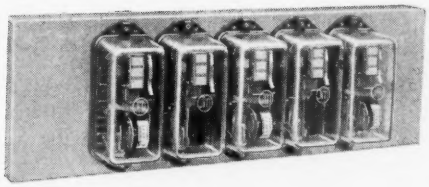
G/A 409

Fluorescent Lighting Equipment

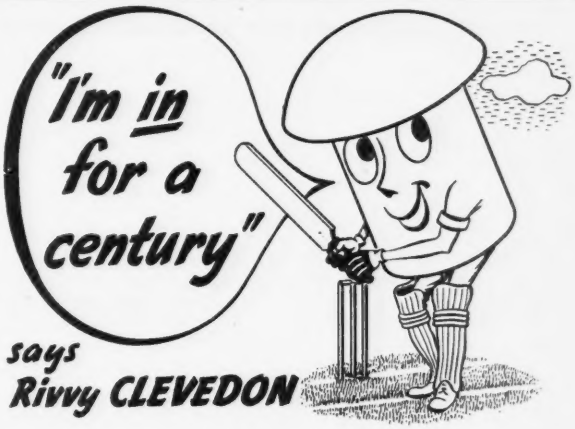
ENSEL ELECTRIC CO., LTD.
218 UPPER STREET, LONDON, N.1
Telephone: CANonbury 2251/2 Grams: Enslectric, London
Send for illustrated leaflets and price lists.

JM
JOHN MORRIS
ELECTRICAL ENGINEERING CO. LTD.
BILSTON TEL. 41237-8 STAFFS

RELAY TRAYS



An example of our type CR control relays mounted in standardised trays



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"I'm just the chap to fill the gap.

My record shows that I've never been caught out nor stumped in any Test."

solid rivets in aluminium, brass, copper, nickel and all light alloys . . .

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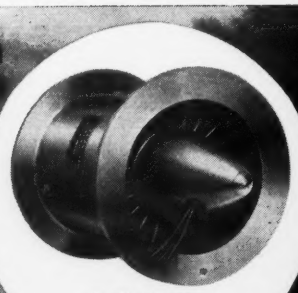
EVERY PARCEL A TRAVELLING SALESMAN

PRINTED GUMSTRIP REGD SEALING TAPE

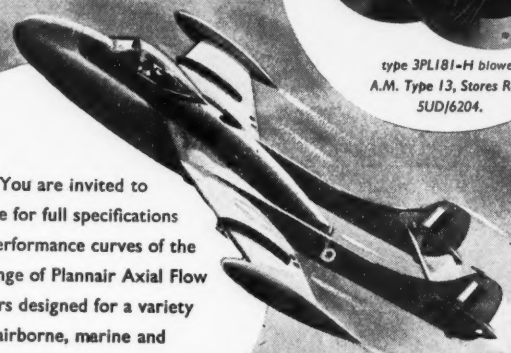
★ SEND FOR LEAFLET 230 P.W.

SAMUEL JONES & CO., LTD.
NEW BRIDGE STREET, LONDON, E.C.4 CENTRAL: 6500

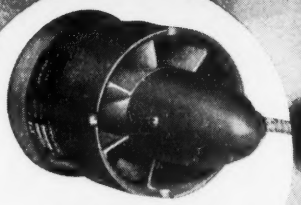
Plannair blowers chosen for the de Havilland Venom Mk.3



type 3PL181-H blower
A.M. Type 13, Stores Ref: 5UD/6204.



You are invited to write for full specifications and performance curves of the wide range of Plannair Axial Flow Blowers designed for a variety of airborne, marine and ground applications.



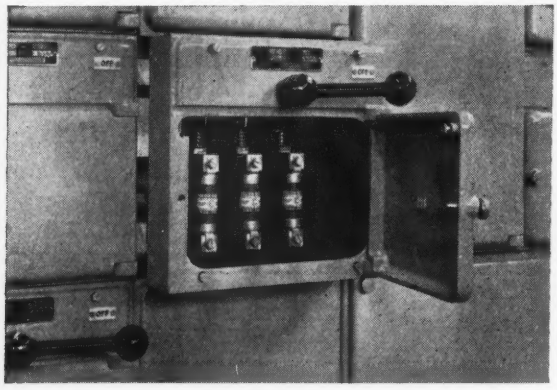
type 2PL81-H blower
A.M. Type 12A, Stores Ref: 5UD/6205.

PLANNAIR
REGISTERED TRADE MARK

FOR THE WORLD'S FINEST AIRCRAFT

PLANNAIR LIMITED WINDFIELD HOUSE LEATHERHEAD SURREY TEL LEATHERHEAD 4091/2231
TELEGRAMS & CABLES: PLANNAIR LEATHERHEAD FACTORY: GOBLIN WORKS LEATHERHEAD
4807/2

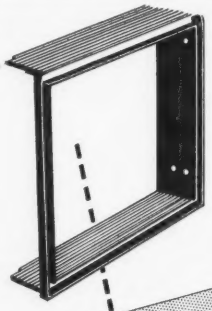
A.S.T.A. TESTED. 30 MVA. 60-750 AMPS.



THE ILLUSTRATION SHOWS THE WITHDRAWABLE FEATURE OF THE SWITCH MECHANISM COMMON TO ALL SIZES OF SWITCH INCORPORATED IN SWITCHBOARDS MANUFACTURED BY

VARILECTRIC
LIMITED
10 MELON ROAD
LONDON, S.E.15

PLEASE WRITE TO TECH. DEPT. 2 : 13 FOR BROCHURE AND LEAFLETS ABOUT THESE AND OTHER PRODUCTS



A COMPLETE SERVICE IN PRESSWORK AND WELDED ASSEMBLIES

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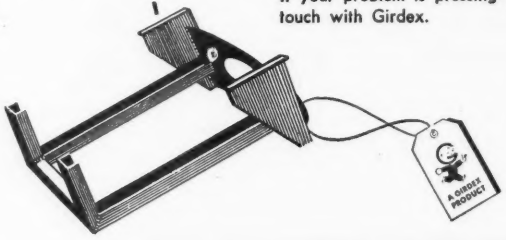
Girdex can offer you a complete and efficient service in presswork, machining and assembly. Repetition or batch-quantity orders receive the same care and attention.

If your problem is pressing—get in touch with Girdex.



GIRDEX ENGINEERING COMPANY LIMITED
WESTON LANE, TYSELEY, BIRMINGHAM 11
Telephone: ACOcks Green 2205 Telegrams: "GIRDEXPRES"

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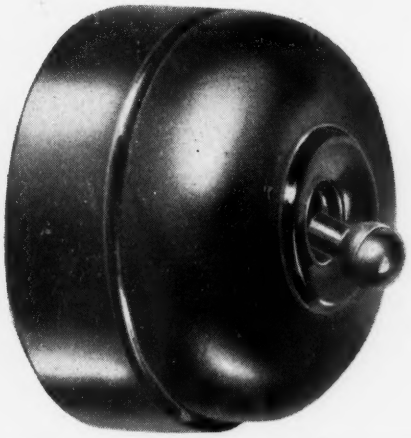


Quick Make & Break Switches

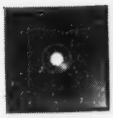
5 and 15 Amp.

by

KERSON

Surface 2011 W

Flush 3037



5031 Flush Plate

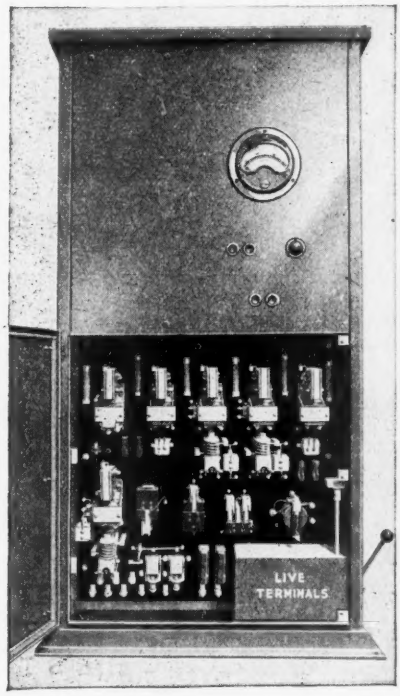
Semi-Recessed 2023 W

Whenever you recommend Kerson switches you recommend safety combined with durability and efficiency. Kerson Q M B switches are available in Surface, Semi-Recessed and Flush Patterns. In the 5 amp. size Flush Patterns are made in gangs of one to four. All models have vitreous porcelain bases, providing maximum insulation qualities.

THE KERSONS MANUFACTURING CO. LTD.

KINGS ROAD TYSELEY BIRMINGHAM 11

Phone: ACOcks Green 0616-7 Grams: Kersons, Phone, Birmingham



Speed control panel of a D.C. compound wound motor for a tube rolling mill

SPECIAL CONTACTOR PANELS

built up from rigidly tested E.M.B. components can be supplied for motors between 10 and 300 H.P. with all types of control, including variable speed control for both A.C. and D.C., furnace, ore grabbing or multi-motor control and all types of crane control.

The services of our electrical designers are at your disposal

E.M.B. Co. Ltd.

WEST BROMWICH—ENGLAND

electrical efficiency by DECO

The comprehensive range includes cable reeling drums and special electrical equipment for all types of handling plant. Special limit and control switches, push buttons and auxiliary devices are available for automatic plants, and winch driven limiting mechanisms can be supplied for shunt and main current circuits.

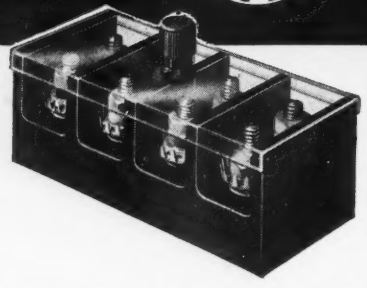
Cable Reeling Drums Winch Driven Limiting Mechanisms Overhead Collector Systems Contact Crane Columns Auxiliary Control Devices for all classes of Material Handling Plants

DECO ENGINEERING CO. LTD., WEST ROW, NORTH KENSINGTON, LONDON, W.10

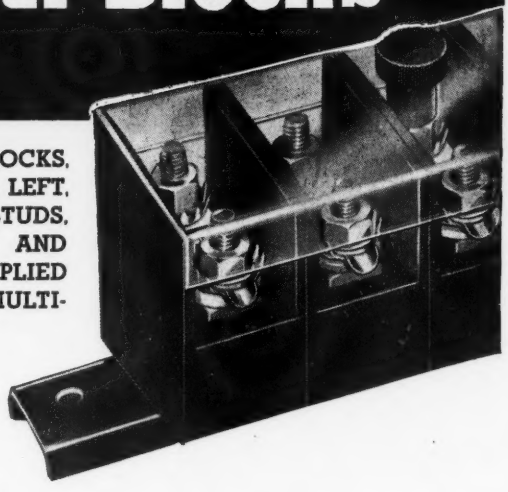
Phone: LADbroke 3066/7
Grams: Etyladec, Wesphone, London

The new ATL Terminal Blocks

FOR CABLES UP TO 7/052



MOULDED 4-WAY BLOCKS, AS SHOWN ON THE LEFT, WITH 2BA BRASS STUDS, LINKS, TERMINALS AND NUTS, CAN BE SUPPLIED BUILT UP INTO MULTI-WAY UNITS.



MOULDED BODY AND SIDE SHIELDS, FITTED WITH 0BA BRASS STUDS, LINKS AND ROSS-COURTNEY TYPE TERMINALS AND NUTS. SUPPLIED AS SINGLE ONE-WAY UNIT OR AS BUILT-UP BLOCKS.

AUSTIN TAYLOR ELECTRICAL LIMITED

ELLESMERE STREET
FAILSWORTH
MANCHESTER
TELEPHONE AND TELEGRAMS :
FAILSWORTH 3246

CW/2496/11

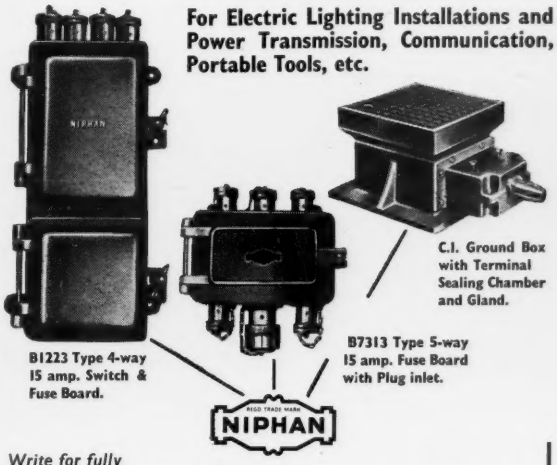
NIPHAN CABLE COUPLINGS

Specialists in the design and manufacture of

WEATHERPROOF C.I. FUSE AND SWITCH FUSE BOARDS
HEAVY C.I. GROUND BOXES

Designs to requirements

For Electric Lighting Installations and Power Transmission, Communication, Portable Tools, etc.


C.I. Ground Box with Terminal Sealing Chamber and Gland.
B1223 Type 4-way 15 amp. Switch & Fuse Board.
B7313 Type 5-way 15 amp. Fuse Board with Plug inlet.
NIPHAN

Write for fully illustrated catalogue to:

SIMMONDS & STOKES (NIPHAN) LTD

VICTORIA HOUSE, SOUTHAMPTON ROW, LONDON, W.C.I
'Phone: HOLborn 2163, 8637. 'Grams: Niphan, Westcent, London

This **HELI-COIL** *insert*

. . . will give you positive protection against wear, stripping and corrosion in all tapped threads. It permits cleaner, more functional design . . .

ARMSTRONG PATENTS CO. LTD.

BEVERLEY, YORKSHIRE Telephone: Beverley 410

* *Registered Trade Mark*

I.B. D/100/C

PROVED IN USE . . .

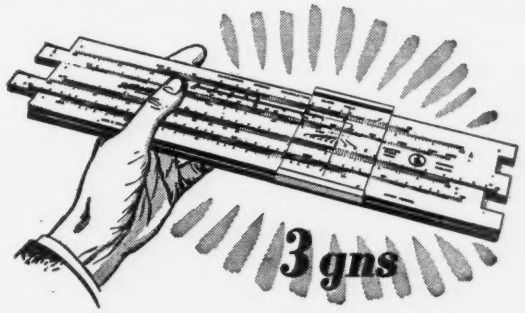
'HAWKE'

CABLE GLANDS AND SEALING BOXES

are made in all metals to suit specific installations. The illustration shows our Cable Gland Sealing Box with running coupler—just one of our series of Cable Glands. Send for a set of our descriptive leaflets.

H. DUNNING & CO. (1946) LTD.

STAMFORD RD. AUDENSHAW NR. MANCHESTER TEL DENton 2828



Cut the stress and strain from spring calculation

with a 'RATCLIFFE' SPRING CALCULATING SLIDE RULE

★ Scales allow all calculations involved in the design of helical tension and compression springs to be made *at one setting!*
★ Upper slide for stress and load calculations!
★ Wahl's stress correction calculated quickly!
★ The rule is essential to engineers and draughtsmen, is soundly constructed and supplied in a strong case complete with instructions.
★ Price £3 3s. 0d. Send for one today.

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THE SPRING SPECIALIST

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PRISMATIC FITTINGS

IN ALUMINIUM ALLOY

The Natural Selection for all installations

List No. SY.10 100 watt

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Always better than they have to be

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MANUFACTURED AT **HILLINGTON, GLASGOW, S.W.2**

by **J. & G. COUGHTRIE Ltd.**

Fans for confined spaces

See how little space is occupied by this 5-stage Woods *Aerofoil* fan . . . how compactly it fits into the ducting. A two-stage contra-rotating fan can develop 7″ s.w.g. It is smaller than a comparable centrifugal, simpler to install, requires no bulky bends, no floor space, and consumes less current. High pressures are no longer the prerogative of the centrifugal fan; Woods multi-stage *Aerofoil* fans can develop 20″ s.w.g. or more. Woods fan engineer in your area will be happy to call. Write for publication V1089.

WOODS for Fans

WOODS OF COLCHESTER LIMITED, BRAISWICK WORKS, COLCHESTER

An associate company of The General Electric Company Ltd.

Birmingham: *Phone: Midland 4421 (Ext. 23 and 68)*
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Glasgow: *Phone: Central 9250 (Ext. 28b)*
Leeds: *Phone: 32171*

Technical Representative at:

Leicester: *Phone: Granby 721*
Liverpool: *Phone: Royal 7282*
London: *Phone: Chancery 5474*
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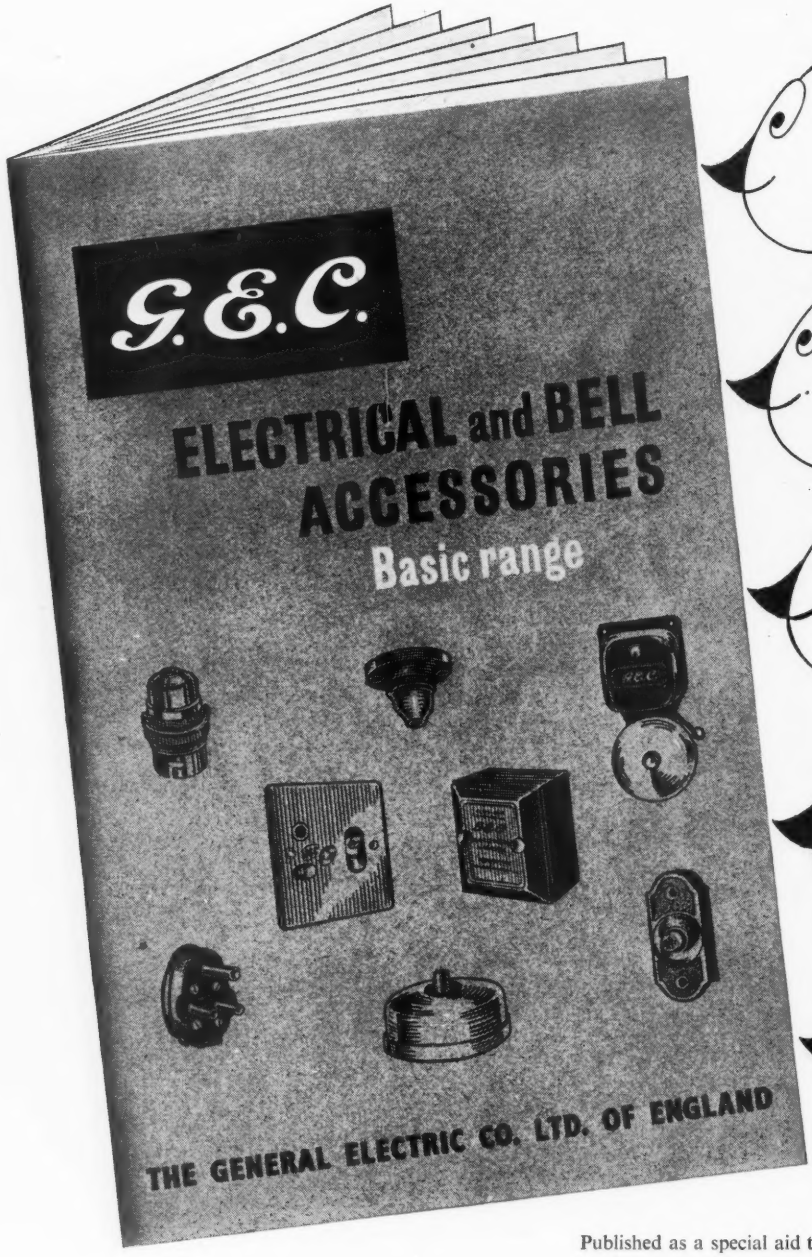
send for this

NEW G.E.C. PUBLICATION



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INDEXED

FOR

EASY

REFERENCE

Published as a special aid to electrical contractors, lighting engineers and retailers, this abridged edition combining G.E.C. electrical and bell accessories catalogue is now available.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE; KINGSWAY, LONDON, W.C.2

CLASSIFIED ADVERTISEMENTS

ADVERTISEMENTS are accepted up to **First Post on Monday** of the week of issue, and should be addressed to Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

CLASSIFIED advertisements are PREPAID at 3/- per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number this counts as two words and carries an additional charge of 1/-.

DISPLAYED:—£2 per inch, per insertion. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

Original testimonials should not be sent with applications for employment

OFFICIAL NOTICES, TENDERS, ETC.

ELECTRICITY (ESSENTIAL SUPPLIES) ACT (NORTHERN IRELAND) 1954

CITY & COUNTY BOROUGH OF BELFAST

Electricity Department

TENDERS are invited for the supply, delivery and erection at the First Extension of Belfast Municipal Electric Power Station West of:—

Two electric level luffing, slewing and travelling Coal Unloading Cranes complete with transfer belt conveyors and automatic belt weighing apparatus. Each coal unloading crane shall be capable of unloading from a collier at the maximum rate of 150 tons of small coal per hour.

Form of tender (N.1423), conditions, specification and drawings, in quintuplicate, may be obtained from Messrs. Merz & McLellan, Consulting Engineers, Carliol House, Newcastle upon Tyne, 1, on payment of a deposit of five guineas, which will be refunded provided a bona fide tender is lodged and not withdrawn. Extra copies of the tender document may be obtained at one guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each tender, in quadruplicate, in sealed envelope marked "Tender for Coal Unloading Cranes, Electricity Department," and endorsed with the name and address of the tenderer, must be addressed to the Town Clerk, City Hall, Belfast, so as to reach him not later than 4 p.m. on Thursday, 3rd February, 1955.

An official receipt must be obtained for each tender delivered by hand. Tenders sent by post should be registered.

The lowest or any tender will not necessarily be accepted.

EYRE GORDON, Chairman,
Northern Ireland Joint
Electricity Committee.

Chichester House,
Chichester Street, Belfast.
20th December, 1954. 6775

CITY OF CARLISLE

SEPARATE tenders are invited for the supply and delivery of the following:—

(a) 74 3/80-w. Fluorescent Lanterns complete with control gear and time switches.
(b) 71 Class A M.V. Lanterns complete with control gear and time switches.
(c) 144 25-ft. mounting height Steel Columns.
(d) The erection of 144 Columns, including wiring and fitting.

Particulars from City Engineer.
Closing date 17th January, 1955.

H. D. A. ROBERTSON,
Town Clerk.
6718

COUNTY BOROUGH OF BOLTON

Sodium Discharge Lighting, Trunk Road A.6

TENDERS are invited for the supply of 66 Street Lighting Units, comprising steel poles, lanterns and ancillary gear for sodium discharge lamps.

Tender forms and specifications may be obtained on application to the Lighting Superintendent, Marsden Road, Bolton, and must be returned in the envelope provided not later than Saturday, 15th January, 1955.

PHILIP S. RENNISON,
Town Clerk.
Town Hall,
Bolton. 6774

BOROUGH OF NEWBURY

Oxford Road (A.34) Lighting Scheme

TENDERS are invited for the supply and erection of 24 Lanterns and Steel Columns in connection with the above scheme as follows:—

1. The supply of electrical equipment.
2. The supply and erection of steel columns together with fitting and wiring of electrical equipment offered in their own tender.
3. The supply and erection of steel columns together with fitting and wiring of electrical equipment provided by another firm.

Form of tender, specification and bill of quantities may be obtained from the Borough Surveyor and Water Engineer, Municipal Buildings, Newbury, at whose office plans and general conditions may be inspected.

Sealed tenders, endorsed "Tender Lighting," must be delivered to the undersigned not later than 9 a.m. Monday, 17th January, 1955. The Corporation does not bind itself to accept the lowest or any tender.

LESLIE SOUTHERN,
Town Clerk.
Municipal Buildings,
Newbury, Berks. 6729

COUNTY BOROUGH OF SOUTHAMPTON

THE Council invites tenders for the Electrical Sub-Contract to the following:—

1. 1 block of 10 shops, 5 flats and 12 maisonnettes.
2. 3 blocks of 12 3-storey traditional type flats.

Application to tender with deposit of £2 2s. for each contract, or Borough Treasurer's receipt for same, must reach the Borough Engineer, Civic Centre, Southampton, by 10th January, 1955. 6767

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Dundee Area

THE Board invites tenders for Multicore High-voltage and Low-voltage Paper-insulated Cables.

Particulars may be obtained on application to the Area Manager, North of Scotland Hydro-Electric Board, Dundee Area, 7, Dudhope Crescent Road, Dundee. 6730

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the Local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order, 1952.

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

North Caledonia Area

APPLICATIONS are invited for the post of DEMONSTRATOR/SALESWOMAN in the Buchan-Banffshire territory of the Board.

Applicants should have at least two years' training in domestic science and be experienced in demonstrating and selling electrical appliances.

Salary in accordance with N.J.C. Grade 1, £400-£490 per annum. Superannuation scheme applicable.

Applications, in confidence, stating age, qualifications and experience, to be addressed to the Area Manager, West Villa, South Street, Elgin, not later than Saturday, 8th January, 1955. 6760

CITY OF SALISBURY, SOUTHERN RHODESIA

Vacancy for Electrical Engineer, Salary Scale £1,450 × £50 to £1,600 (Professional Officer, Grade 3)

APPLICATIONS are invited for the position of an ELECTRICAL ENGINEER (Professional Officer, Grade 3) in the salary scale £1,450 × £50 to £1,600 per annum.

Candidates should possess a degree in electrical engineering or the equivalent, and/or be Corporate Members of the British Institution of Electrical Engineers, and have had at least 15 years' experience in the design, erection and maintenance of indoor and outdoor substations, transformers, switchgear, protection, etc., up to and including 33,000 volts.

The position is a senior post and the selected candidate will be in charge of the substation section of the distribution department of an undertaking covering approximately 700 square miles and some 690 substations, with a present system maximum demand of 70 MW; experience in general distribution work and in the control of staff in an organisation of at least similar size is essential.

The appointment will be subject to Council's service and leave regulations, which will be made available for inspection at the offices of the undersigned. The salary payable will commence at the minimum of the above scale and rise by annual increments to the maximum; no cost-of-living or other allowances are payable.

The successful candidate must be able to comply with the regulations of the Southern Rhodesian Immigration Authorities, and will be required to submit a satisfactory medical certificate of fitness.

Applicants are requested to submit full particulars of their qualifications, training and experience, giving details of positions held and salaries received, marital state, age, place of birth, and nationality. Copies of not more than three recent testimonials may be included.

Canvassing, directly or indirectly, will be a disqualification.

Applications, suitably endorsed on the cover, must reach the offices of the undersigned, from whom further particulars can be obtained, on or before the 22nd January, 1955. Air mail paper should be used.

DAVIS & SOPER LTD.
52-54, St. Mary Axe,
London, E.C.3.
22nd December, 1954. 6770

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Fort Halstead, Kent

EXPERIMENTAL OFFICER or ASSISTANT EXPERIMENTAL OFFICER required to perform experimental physical research using small explosive charges and high-speed recording equipment. The minimum qualification is Higher School Certificate (Science) or equivalent. Experience in the handling of explosives together with some knowledge of electronics would be an advantage. For the Experimental Officer post a pass degree in physics is desirable.

The salary scales are: Experimental Officer £715-£880 (male) per annum (minimum age 26); Assistant Experimental Officer £288 10s. (at age 19) to £640 (male) per annum. The successful applicant will be required to join the Authority's Principal Superannuation Scheme to be introduced shortly, and the salary scale quoted above will be enhanced to cover contributions.

This post will ultimately be located at Foulness, Essex. Application form from Senior Recruitment Officer, A.W.R.E., Aldermaston, Berks. Quote ref. 146/WCE/48. 6754

GOLD COAST LOCAL CIVIL SERVICE

VACANCIES exist for (a) ENGINEERS (BCD.108/13/03) and (b) WIRELESS ENGINEERS (BCD.108/13/04) in the Posts and Telecommunications Department of the Gold Coast Local Civil Service.

Appointments are on contract for 2 tours in the salary range £1,130-£2,020 per annum, point of entry depending on professional experience and age. A gratuity of £37/10s. is payable for each completed 3 months' satisfactory service. Free first class passages are provided for the officer, his wife, and up to 3 children under 13 years of age, and government quarters, if available, are provided at a rental of £60-£90 per annum. Leave is granted at the rate of 7 days for each completed month of resident service after a tour of 18-24 months.

Candidates must be between 23-45 years of age and have passed or be exempt from Parts A and B of the examination of the Institution of Electrical Engineers, and have had at least two years' practical training in the Engineering Department of the British Post Office or with one of the large telecommunications equipment manufacturing firms in the United Kingdom. Candidates for (b) should have had experience with H.F. and V.H.F. fixed and mobile equipment and air and sea navigational aids. Knowledge and experience of power generation would be an advantage. Candidates possessing more than minimum qualifications and with a wide knowledge and experience of telecommunications practice and administration will be given preference.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number shown against the post applied for. 6759

AN INTERNATIONALLY KNOWN ENGINEERING COMPANY

are seeking the services of a

FULLY QUALIFIED ELECTRICAL ENGINEER

as District Post Commissioning Engineer for Scotland, Ireland and the N.E. of England.

The duties will include considerable travel away from home, in the technical liaison with customers, and with consequent dealings with engineers of all levels. Applications are invited from suitably qualified engineers, not less than 30 years of age and who reside in the Glasgow area, who have at least A.M.I.E.E. or similar membership. A mechanical background would be an added advantage, and the work involves knowledge of water turbines, steam turbines and diesels, in addition to electrical gear. The successful candidate should preferably have had similar experience to the above, but a comprehensive course will be given at the company's works prior to assuming the appointment.

A company car and commensurate salary, with staff pension scheme after qualifying period, are provided with the post. Please apply in strict confidence with full details of qualifications, etc., to— Box 6777.

COLNE VALLEY SEWERAGE BOARD

SHIFT ELECTRICIAN required. Must be fully skilled in H.T. generation and distribution and capable of undertaking maintenance work on switchgear generating plant, transformers, works distribution system, motors, etc.

Average wage £10 17s. 10d. per 48-hour week. Permanent pensionable job for right man. Housing accommodation may become available.

Full particulars with names of two referees to Chief Engineer, Maple Lodge, Maple Cross, Rickmansworth, as soon as possible. 6769

SOUTH WEST SCOTLAND ELECTRICITY BOARD

Lanarkshire Sub-Area

Second Assistant Engineer (Test)

APPLICATIONS are invited for the appointment of SECOND ASSISTANT ENGINEER (Test) in the Sub-Area Protection and Transformer Testing Station at Motherwell.

Candidates should be Corporate Members of the Institution of Electrical Engineers, and an engineering degree or its equivalent is desirable. Applicants should have had a sound engineering training with subsequent experience of commissioning, testing and maintenance of H.V. feeder and transformer protection circuits, and all laboratory and field tests appertaining to a large distribution system. Applicants should also have had experience in the organisation and operation of a transformer and protective gear testing station. Experience of electronic and telecommunication circuits would be an advantage.

The salary and conditions of service will be in accordance with the National Joint Board's Agreement, Schedule A (revised), the present classification and grading being K.7, salary (revised) £975/£1,050 per annum, which will be subject to the statutory deductions, including superannuation. The successful candidate will require to reside within a reasonable distance of the transformer testing station at Motherwell.

Application forms, which may be obtained from the undersigned, should be forwarded to this office within 14 days of the date of this advertisement.

DUGALD SMITH,
137, Almada Street, Manager.
Hamilton. 6781

BRITISH ELECTRICITY AUTHORITY

Midlands Division

APPLICATIONS are invited for the following positions in the Generation (Operation) Department. N.J.B. service conditions, superannuable appointments, salaries within Schedule A of the Agreement:—

(a) SHIFT CHARGE ENGINEER at Nechells "A" Power Station, Grade F.7, commencing salary £755 per annum (Vacancy No. 844MD).
(b) MAINTENANCE ENGINEER (Mechanical) at Stoke Power Station, Grade E.6, commencing salary £755 per annum (Vacancy No. 845MD).
(c) JUNIOR ENGINEER at Hams Hall "B" Power Station, Grade K.18, commencing salary £475 per annum (Vacancy No. 846MD).

Applicants for these positions should have received sound technical training and practical experience, in particular for (a) in the operation and maintenance of steam generating plant, including pulverised fuel-fired boilers and main switchgear, and for (b) in the maintenance of power station mechanical plant. Appropriate technical qualifications an advantage.

Apply, quoting the vacancy number, on form AE6, available from the Establishments Officer, 53, Wake Green Rd., Moseley, Birmingham 13, by 10th January, 1955. 6733

BRITISH ELECTRICITY AUTHORITY

Headquarters, London

SENIOR ASSISTANT ENGINEER required to be responsible for co-ordinating construction work at a group of power stations.

Duties will entail attendance at site meetings and visits to power stations. Practical experience in construction of modern power stations, including handling of contracts, preparation of commissioning programmes, work on site and co-ordination of projects from inception to commissioning is essential.

Candidates should preferably be Corporate Members of the I.Mech.E. or I.E.E.

Salary N.J.B. Grade 1, £1,150-£1,500 p.a. inclusive.

Applications, stating age, qualifications, experience and present position and salary, should be forwarded to Director of Establishments, Winsley Street, London, W.1, by 17th January, 1955. Quote ref. ER/551. 6752

SOUTH WEST SCOTLAND ELECTRICITY BOARD

Lanarkshire Sub-Area

(1) General Assistant Engineer, Sub-Area Planning & Development Dept.
(2) General Assistant Engineer, Sub-Area Operation & Maintenance Dept.

APPLICATIONS are invited for the above appointments. Candidates for these appointments should have had a sound engineering training, followed by some experience in the distribution side of the electricity supply industry.

The salary and conditions of service for each appointment will be in accordance with the National Joint Board's Agreement, Schedule A (revised). The present classification and grading for each appointment is K.13, salary (revised) £675/£720 per annum, which will be subject to the statutory deductions, including superannuation.

The successful candidates will require to reside within a reasonable distance of the Sub-Area Offices at Hamilton.

Application forms, which may be obtained from the undersigned, should be returned to this office within 14 days of the date of this advertisement.

DUGALD SMITH,
137, Almada Street, Manager.
Hamilton. 6780

ELECTRICAL AND MECHANICAL ENGINEERS

SUNVIC CONTROLS LTD. (a subsidiary of Metropolitan-Vickers Electrical Co. Ltd.) have the following vacancies in their new Development and Production Units at Harlow.

(1) GRADUATE ENGINEER with general works training and experience on the design of domestic control equipment. Applicants must be familiar with modern methods of manufacture and have some knowledge of mass production techniques.
(2) GRADUATE ENGINEER with experience in design or development of electro-mechanical mechanisms and their application to instrument problems.

The above positions are permanent and offer excellent prospects for promotion in a team engaged on the development and manufacture of a wide range of new instruments. Salaries will be according to age and ability. The company's contributory pension scheme applies in all cases, and housing is available if required.

Reply in writing, giving full particulars of age, experience, qualifications and present situation, to Chief Engineer, Sunvic Controls Ltd., Harlow, Essex. 230

BRITISH ELECTRICITY AUTHORITY

South Eastern Division

GENERAL ASSISTANT ENGINEER (Transmission), Brighton District. Preference will be given to applicants with experience of installation or maintenance of high-voltage equipment, and of the operation of the Safety Rules (Transmission). Higher National Certificate or equivalent qualifications. Duties may involve construction work.

N.J.B. conditions of service, Class AX/DX, Grade 6, commencing at £600 p.a., rising ultimately to £785 p.a.

Applications giving details of education, experience, present position, etc., should be received by the Establishments Officer, British Electricity House, Lower Ham Road, Kingston-upon-Thames, not later than 10th January, 1955. 6768

DESIGNER-DRAUGHTSMEN

KEIGHLEY LIFTS Ltd. invite applications for vacancies in mechanical and in electrical design departments. Experience in electric lift work a distinct advantage, but all applications will be given full consideration. For capable men these are permanent situations in an expanding company. Non-contributory pension scheme and canteen facilities. Please forward written applications, with full details of age, experience, etc., to Keighley Lifts Ltd., Dalton Lane, Keighley, Yorks. 6734

UGANDA ELECTRICITY BOARD

APPLICATIONS are invited for a post overseas as METER TESTER. Candidates should have experience in a Class A polyphase meter testing station and be capable of testing and repairing meters of all types used on supply undertakings. Experience with summation metering equipment and the testing of instruments (including standardisation) would be an advantage. Technical qualifications to H.N.C. or O.N.C. desirable.

Salary according to age and experience will be in the scale £990 × £30 to £1,110, and on passing a proficiency bar, by further increments of £30 to £1,260 per annum.

Uganda has a pleasant climate, income tax is moderate, and the salaries, which have recently been revised, are reasonable in relation to the cost of living. Free passages, partly furnished accommodation, medical and dental treatment. Vacation leave on full pay after three years' service.

Application forms and further information may be obtained from the London representative, Uganda Electricity Board, 27, Regent St., London, S.W.1.

Closing date for applications, 15th January, 1955.

C. R. WESTLAKE,
Chairman. 6731

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ENGINEER, Thanet District. Salary £840-£900 p.a. under N.J.B. Class E, Grade 4. Superannuable. Applicants should have considerable experience of domestic, rural and industrial development of electricity supply and a thorough knowledge of organisation of a commercial department, estimating for installation work, tariffs, apparatus, metering, public lighting and showroom management.

Applications, naming 2 referees, to H. J. C. Carte, M.B.E., A.I.E.E., Thanet District Manager, SEEBoard, Electricity Works, St. Peter's, Broadstairs, Kent, by 12th January, 1955.

SALES REPRESENTATIVE, Reigate District. Salary £400-£490 p.a. under N.J.C. Grade 1. Applicants must have a sound practical training with experience in installation work for domestic, commercial and industrial premises, with a good knowledge of domestic appliances and ability to advise consumers regarding the use of electrical apparatus. Possession of the E.D.A. Salesmanship Diploma an advantage.

Applications, naming 2 referees, on forms from C. Rowbotham, M.I.E.E., District Manager, SEEBoard, 6 & 8, Linkfield Corner, Redhill, Surrey, by 12th January, 1955.

A. L. BURNELL,
Secretary. 6732

MIDLANDS ELECTRICITY BOARD

SENIOR ASSISTANT ENGINEER required at Sub-Area Headquarters at Gloucester. Applicants will be required to assist in the development of the industrial and commercial utilisation of electricity supplies. Wide experience of electrical development is essential. Technical qualifications desirable. Salary £975/£1,050 per annum (N.J.B. Grade H.5). Superannuable.

Apply within fourteen days, stating age, experience, present salary and position, to Mr. D. Holt, Sub-Area Manager, Midlands Electricity Board, 126, London Road, Gloucester.

A. STEPHENS,
Secretary. 6755

BRITISH ELECTRICITY AUTHORITY

South Wales Division

Vacancy No. 123/54

APPLICATIONS invited for superannuable N.J.B. appointment of SHIFT CHARGE ENGINEER at Llanelly Power Station. Salary E.7, £715 × £15 to £760 per annum.

Applicants should preferably have obtained H.N.C. and served a regular apprenticeship. Operating experience in a power station is essential.

Application forms obtainable from Secretary, South Wales Division, British Electricity Authority, Twyn-y-Fedwen Road, Gabalfa, Cardiff, to be returned by 7th January, 1955. 6756

NORTH WESTERN GAS BOARD

Liverpool Group

Electrical Supervisors

APPLICATIONS are invited for the above pensionable appointment at a salary within Grades A.P.T. 5/7 (£500-£655 per annum).

Applicants should have experience in the operation, repair, maintenance and installation of A.C. and D.C. motors and starters up to 500 h.p., H.V. and M.V. switchgear and fusegear, rectifiers, P.I.L.C.S.W.A. & S. cables and conduits.

Previous experience in the control of electrical personnel, and technical qualifications, would be an advantage.

Applications should be made on the official form obtainable by writing to the Chief Personnel Officer, N.W.G.B. (Liverpool Group), Radiant House, Bold Street, Liverpool, 1, and returned to him within 14 days. 6753

DRAUGHTSMEN AND DESIGNERS

E. K. COLE LTD., Ekco Works, Southend-on-Sea, have the following vacancies:—

MOULD DESIGNERS and JIG & TOOL DRAUGHTSMEN for the Plastics Division.

ELECTRONIC, RADIO & TELEVISION DESIGNERS AND DRAUGHTSMEN for Development and Engineering Departments.

MECHANICAL DRAUGHTSMAN for plant layout in the Production Engineering Department.

Applications to the Personnel Manager, Southend-on-Sea 49491. 6776

ADMIRALTY, BATH

require

TEMPORARY ELECTRICAL DRAUGHTSMAN TRAINEES. British subjects only, aged 21 and over, and having served apprenticeship or had equivalent workshop experience in one or more branches of electrical engineering in factories or shipyards.

Free training in drawing and electrical technical knowledge, beginning February, 1955, at Bath Technical College, before grading as draughtsmen. Normal salary during training.

Salary according to age, qualifications and experience, £400 at 21 to £550 at 28, thence to maximum of £640.

Apply, giving details of qualifications and experience, to any Employment Exchange, quoting Bath 1321. 6676

ELECTRICAL ENGINEER-DRAUGHTSMAN URGENTLY REQUIRED

ASSISTANT ENGINEER - DRAUGHTSMAN, preferably with some experience of battery-electric traction units, D.C. switchgear, etc., required in design office of well-known manufacturers of fork lift trucks and battery electric vehicles.

Apply in confidence, giving full details of experience, qualifications, and salary required, to:

Chief Designer,
AUSTIN CROMPTON PARKINSON ELECTRIC VEHICLES LIMITED,
Webb Lane, Birmingham, 28. 224

A VACANCY has occurred for the position of senior electrical engineer with first-class qualifications on the staff of a well-known electrical contracting firm in Cardiff. Experience of contracting, as opposed to manufacturing, essential. Write stating education, qualifications, age, experience and salary required, to—Box 6693.

AN experienced D.C. designer capable of using his initiative required for interesting work on dynamo electric machines from 5 to 5,000 h.p./kW. A superannuation scheme in operation and the usual social amenities available in an organisation of progressive outlook. All applications will be treated with the strictest confidence and should be addressed to—The General Manager, Lancashire Dynamo & Crypto Ltd., Trafford Park, Manchester, 17. 6219

A MAN of ideas and experience in the use and control of electricity for industrial and domestic purposes required as part-time consultant. Write stating age, experience and remuneration to—Box 6778.

ADVERTISER is looking for the best development engineer in Great Britain for household appliances. For the right man this is a wonderful opportunity. Applicant must have ideas for entirely new types of household appliances or for substantial improvements to existing appliances, and must not only be able to develop these to the stage of prototypes but also to develop for mass production. Write—Box R444, c/o Jackson's, 54, Old Broad Street, London, E.C.2. 6764

ASSISTANT electrical engineer required in London area for work in connection with the design of electrical installations for all types of buildings. Previous consulting or contracting experience desirable and ability to draw and prepare specifications essential. Write giving age, full details of experience and salary required to—Box ER.883, L.P.E., 55, St. Martin's Lane, London, W.C.2. 6735

CABLE estimator required, age about 25 years, with experience in cable design and works estimates. Central London area. Please send full details to—Box 6710.

CONSULTING engineers in Westminster invite applications for engineering and drawing office staff for work on hydro-electric power stations. Applicants for positions as assistant and junior engineers should have served an engineering apprenticeship with subsequent design, contract or field experience on water turbines, alternators or mechanical plant. Some electrical experience is also desirable. An engineering degree with Associate or Graduate Membership of the Institution of Mechanical Engineers or its equivalent is essential. Draftsmen should have good experience on design and layout of heavy plant. Salaries will depend on experience and qualifications. Applications should reach Kennedy & Donkin, 12, Caxton Street, Westminster, London, S.W.1, not later than 24th January, 1955. 6758

CONTRACTORS require fully experienced L.T. and E.H.T. cable jointers for work in Midland area. Able to drive an advantage. Please apply in the first instance to—Box 6601.

CROMPTON PARKINSON Ltd. require both senior and junior draughtsmen at their Chelmsford works. Applicants should have either contract, development or diagram experience on switchgear up to 11 kV, although men with general electrical or mechanical experience will be considered. Ideal terms of employment. Apply giving full particulars to the Personnel Officer. 226

DESIGN engineers required for work on the development of large outdoor high-voltage oil circuit breakers. This work is of a senior and permanent nature. Experience in the development of this type or similar equipment is essential. Superannuation scheme in operation. Reply stating age, experience and qualifications to — Personnel Officer, Cooke & Ferguson Limited, Switchgear Specialists, Victoria Street, Openshaw, Manchester, 11. 6736

DESIGNER - draughtsmen required with mechanical and/or electrical experience. A.E.S.D. rates paid to suitable men. Superannuation scheme in operation. Reply stating age, qualifications and experience to—Personnel Officer, Cooke & Ferguson Limited, Switchgear Specialists, Victoria Street, Openshaw, Manchester, 11. 6737

DRAUGHTSMAN required by consulting engineers for the reproduction of electric light and power schemes. Previous experience essential. Write, stating age, experience and salary required, to—E. Wingfield-Bowles and Partners, 32, Old Queen Street, Westminster, London, S.W.1. 157

DRAUGHTSMAN required with experience of metalclad medium-voltage switchgear. Unfurnished house available. A.E.S.D. rate minimum. Reply stating age and experience to—Ottermill Switchgear Ltd., Ottery St. Mary, Devon. 6738

ELECTRICAL draughtsman required for the electrical division of the engineering department of medium/heavy engineering industry. Should have experience in preparation of drawings for electrical installation work and circuit diagrams. Applications to—Personnel Manager, Ruston-Bucyrus Ltd., Excavator Works, Lincoln. 6604

DRAUGHTSMAN. Previous experience in motor control equipment circuit work helpful but not essential if applicant is up to O.N.C. standard. Good salary and prospects. For successful applicant requiring housing accommodation assistance may be given for skilled and key personnel. Pension scheme; 5-day week; canteen. Details of age, experience, qualifications and commencing salary to —The Personnel Officer, Dewhurst & Partner Ltd., Inverness Rd., Hounslow, Middx. 6771

ELECTRICAL RESEARCH ASSOCIATION. Technical assistant required for research on applications of electricity in horticulture. Qualifications expected are a good degree in electrical engineering or physics with some knowledge of electronics. Research experience an advantage. Starting salary will be in the range of £500-£600 p.a., with superannuation provisions. Applications should be addressed to the Director, E.R.A. Field Station, Shinfield Green, Nr. Reading, to arrive not later than 10th January, 1955. 6739

ESTIMATORS for indoor sales staff required by Crompton Parkinson Ltd., Chelmsford. Applicants must have initiative and be experienced in dealing with enquiries relating to A.C. and D.C. rotating electrical machinery up to 1,500 h.p./kW. Superannuation scheme and extensive social, sports and welfare facilities. Write giving fullest particulars to—The Personnel Officer. 6761

FULL-time representative required by well-established manufacturers of high-grade switches, to cover the Northern Counties of England. Pleasant personality and contacts with leading electrical manufacturers and area boards. Knowledge of switching applications, particularly packet, rotary and toggle switches, an advantage. Reply giving full details, including experience, remuneration expected, and whether a car owner, to—Box 6606.

GENERAL representative with ability required by a leading electrical engineering company for the county of Hertfordshire. Write with full details of age, experience, qualifications and salary required to—Box 8225, c/o Charles Barker & Sons Ltd., 31, Budge Row, London, E.C.4. 6740

JUNIOR technical assistant required for illuminating engineering department of old-established manufacturers of lighting equipment for the preparation of lighting schemes, etc. Apply in writing stating age, experience and salary required to—Chief Engineer, Technical Service Dept., Holophane Ltd., Elverton St., Westminster, London, S.W.1. 6694

JUNIOR technical assistant required by London chartered patent agents with a view to training for qualifying as a patent agent. Degree standard in electrical or mechanical engineering. Write giving details of age, experience, etc., to—Box 3583, c/o Whites Ltd., 72, Fleet Street, London, E.C.4. 6713

LABORATORY technician required for the electrical engineering department for work in the electronics field. Commencing salary according to age and experience in the scale £315 × £15 to £450 plus London weighting (max. £30). The successful applicant must join the contributory pension scheme. Application, giving age and full details of experience, to —Secretary, King's College, Strand, London, W.C.2. 6741

LAYOUT draughtsman required by consulting engineers for electrical layout work, including E.H.V. and L.V. outdoor substations, indoor switchgear and cable diagrams. Salary in accordance with qualifications. Apply in writing, reference KJB/RFS, to Messrs. Kennedy & Donkin, 12, Caxton Street, London, S.W.1. 6714

LINESMEN required by contractors for work on H.T., L.T. and steel tower lines in the Midlands. Please apply in the first instance to—Box 6602.

MIDDLE EAST. Required by well-known British firm, a qualified electrical engineer for sales work, single man preferred. Apply in own handwriting stating age and qualifications to—Box R.842, c/o Streets, 110, Old Broad Street, London, E.C.2. 6779

OLD-established electrical wholesale company requires representative for Wolverhampton and Black Country area to call on industrial users. Substantial existing connection handed over to man of personality able to introduce additional trade. Own staff notified.—Box 6696.

MAINTENANCE engineer required by Messrs. Igranic Electric Co. Limited, Bedford, a subsidiary company of Metal Industries Limited. The person appointed will liaison with the civil engineer on all building projects, etc., and be responsible for the preservation of all existing fabric. There is scope for a man who is conversant with, and able to advise on, factory layout. The post is permanent and pensionable. Please apply marking your letter 106.ME, stating age, experience and present salary, to—The Group Training & Personnel Officer, Metal Industries Ltd., 60-62, Buckingham Palace Road, London, S.W.1. 6757

POWER engineer required for large paper mill near Ellesmere Port. Applicants must be qualified combustion engineers with good experience of turbine plant and auxiliaries. Reply giving full particulars of experience and stating age and salary required to—Bowater's Mersey Paper Mills Limited, Ellesmere Port, Cheshire. 7788

PRODUCTION manager wanted by light electrical engineering firm in Bradford, Yorkshire. 700 employees. To be fully responsible for production planning and layout. Time and motion study and tooling. Please apply in the first instance giving qualifications, age and salary expected to—Box 6715.

SALES engineer required for Glasgow office. Permanent and progressive position. Some electrical knowledge desirable.—Higgs Motors, 74, York Street, Glasgow. 6742

SENIOR and junior draughtsmen required, with experience of power transformers. Experience on on-load voltage regulators an advantage. Good salary, rates above A.E.S.D. minimum, contributory pension scheme. Apply stating age, experience and salary required to—Brentford Transformers Ltd., Kidbrooke Park Road, London, S.E.3. 6772

SENIOR estimator required with initiative and having experience in handling comprehensive enquiries involving rotating electrical machinery up to 5,000 h.p./kW. A superannuation scheme in operation and the usual social amenities available in an organisation of progressive outlook. Promotions inside and transfers to sales normally made from staff. All applications will be treated with the strictest confidence and should be addressed to—The General Manager, Lancashire Dynamo & Crypto Ltd., Trafford Park, Manchester, 17. 6218

SENIOR or junior draughtsman required for work on electrical power resisters and large electrical heaters for industrial applications. Previous experience on this class of work is desirable but not essential. Apply giving full details, including age, technical qualifications, whether married or single, and salary required, to—The Expanded Metal Co. Ltd., Electrical Dept., Stranton Works, West Hartlepool. 6586

STOREKEEPER required, 1st Jan., 1955. Duties include control of stores and transport. Experienced electrical trade preferred. Written applications giving full details in confidence are invited.—The Etna Lighting & Heating Co. Ltd., 293/5, Broad Street, Birmingham, 1. 6762

STREET lighting assistant (25/30 years), competent to prepare estimates, required by large company of electrical engineers in Central London. Experience in street lighting equipment essential. Pension fund. Send full details of age, experience and salary required to—Box 6780.

TEST engineer, age 25-40, required by electrical engineering organisation specialising in the production of variable speed driving equipments for use in the printing industry. Previous experience with electronic equipment is essential, and some knowledge of variable output voltage rectifier equipment and/or variable speed A.C. motors would be an advantage. Write, stating age, experience and salary required, to—General Manager, Witton-James Ltd., The Hyde, Hendon, London N.W.9. 6773

YOUNG electrical and mechanical engineers required. H.N.C. standard as a minimum qualification. For vacancies in planning, drawing office and technical departments of modern factory producing tubular sheathed high-temperature heating elements and appliances in West Riding of Yorkshire. Apply, giving full details of age, qualifications and experience, to—Box 6763.

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

ENGINEER EXECUTIVE

A.M.I.E.E., A.M.I.I.A., with excellent production and sales record, seeks appointment (home or overseas) with reputable concern which values integrity, good human relationship, service and enthusiasm as the foundation of successful business.—Box 7786.

CABLE jointer and mate require contract work. Long and varied experience on all classes of cables. Splendid references.—Box 7784

ELECTRICAL engineer, age 28, experienced estimating, drawing, supervision, seeks position with go-ahead firm where remuneration is in comparison with results obtained.—Box 7787.

ENGINEER (35), qualified and widely experienced in precision/instrument electro-mechanical/electronic design, development and liaison; seeks position in which ability, energy and loyalty can be well utilised.—Box 7778.

WORKS manager, A.M.Int.B.E., engineering, desires change. Extensive experience in all aspects of factory organisation. Smart car available.—Box 7789.

AUCTION NOTICES

Twenty-fourth Sale **E. R.**

By Order of the Minister of Supply

M.O.S. STORAGE DEPOT, RUDDINGTON
(Five miles south of Nottingham, on the main Nottingham-Loughborough road).

WALKER, WALTON & HANSON
in association with
TURNER, FLETCHER & ESSEX and RICHARDSON & LINNELL
will Sell by Auction on
TUESDAY, 11th JANUARY, 1955,
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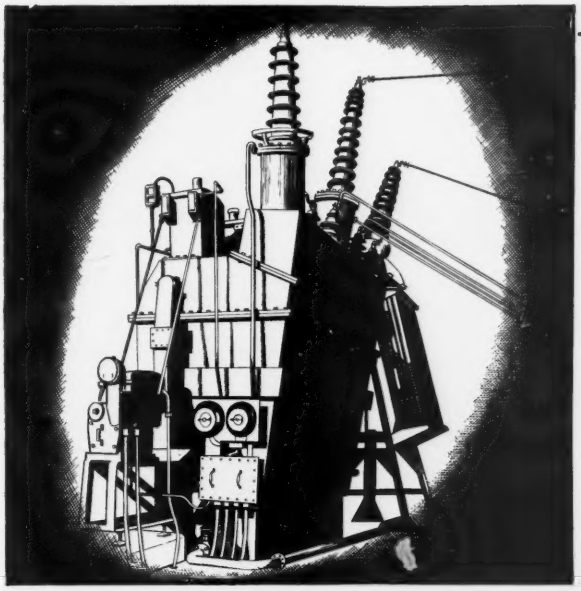

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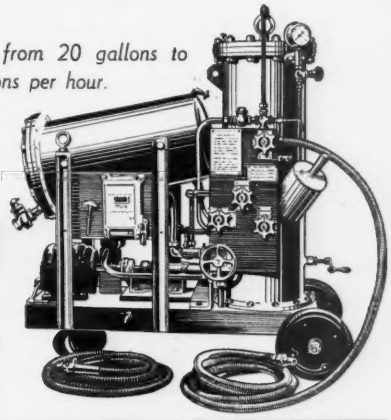

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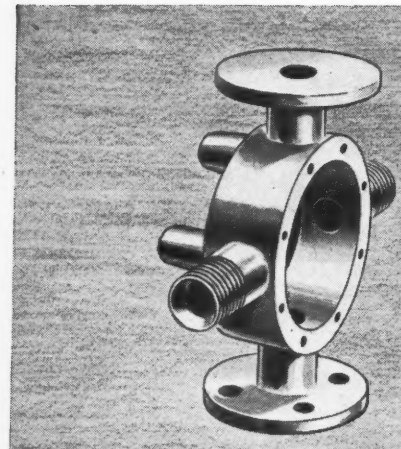

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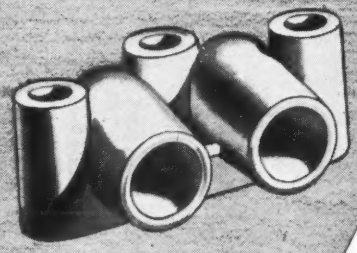

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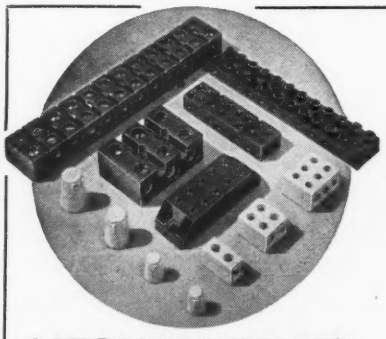

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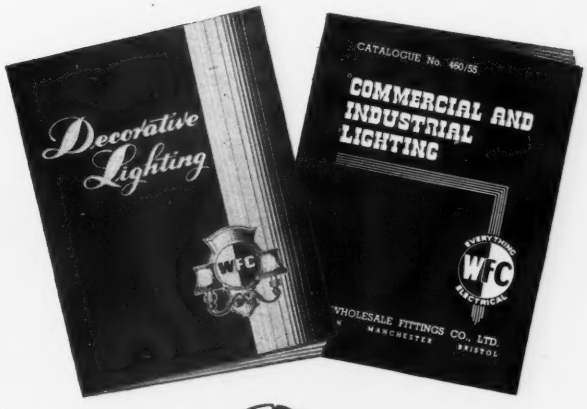

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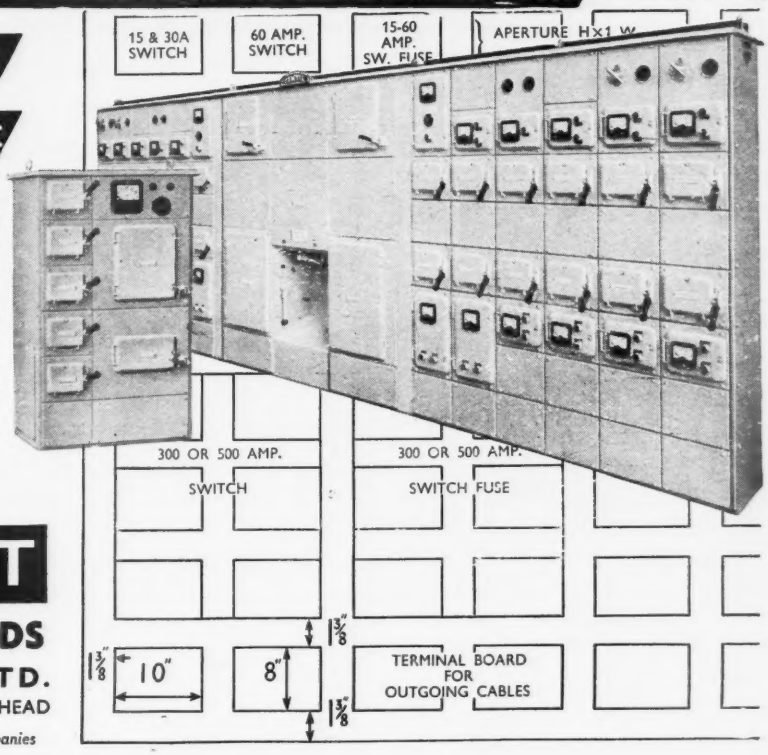

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Belling & Co. Ltd. 12
Benjamin Electric Ltd. 2
Bill Switchgear Ltd. 3
Birch, H. A., & Co. Ltd. 6
Birmingham Battery & Metal Co. Ltd. 34
Black & Decker Ltd. 37
British Driver-Harris Co. Ltd. 9
British Insulated Callender's Cables Ltd. ..... Cover 2
British Klockner Switchgear Ltd. ... 38
British National Electrics Ltd. 49
Brook Motors Ltd. 11
Brush Electrical Engineering Co. Ltd. 19

Cantie Switches Ltd. 95
Carron Co. 71
Channel Conduits Ltd. 42
Clevedon Rivets & Tools Ltd. 79
Connaught Rooms 66
Connollys (Blackley) Ltd. 77
Contractors, Electrical, Regional Guide to ..... 97 & 98
Cosmocord Ltd. 14
Coughtrie, J. & G., Ltd. 84
Craig & Derricott Ltd. 34
Crofts (Engineers) Ltd. 30
Crompton Parkinson Ltd. 21
Crosslands (Rugeley) Ltd. 68
Cryselco Ltd. 36

Dacier Ltd. 94
Daly (Condensers) Ltd. 54
"Davu" Wires & Cables 98
Deco Engineering Co. Ltd. 82
Dewhurst & Partner Ltd. 13
Dubilier Condenser Co. (1925) Ltd. 65
Duncan Low Ltd. 53
Dunning, H., & Co. (1946) Ltd. ... 83

Edison Swan Electric Co. Ltd. 52
E.F. Electric Ltd. 66
Electric Construction Co. Ltd. 50
Electric Depôt Ltd. 76
Electric Elements Co. 20
Electrical Products (Colne) Ltd. ... 57
Electrical Screw Ltd. 16
Ellison, George, Ltd. 47
E.M.B. Co. Ltd. 81
Engineering & Lighting Equipment Co. Ltd. 40
Engineering Products Ltd. 32
Ensel Electric Co. Ltd. 79
Evans, Frederick W., Ltd. 72
Everett Edgcumbe & Co. Ltd. 64
Evershed & Vignoles Ltd. 51
Excelall Metal Workers Ltd. 76

Ferranti Ltd. 45
Fibreglass Ltd. 70
Fitter & Poulton Ltd. 16

Geipel, Wm., Ltd. 68
General Electric Co. Ltd. Cover 1, 29 & 86
Girdex Eng. Co. Ltd. 80
Godwin, H. J., Ltd. 32
Guide to Electrical Contractors, Regional ..... 97 & 98

Hackbridge & Hewittic Electric Co. Ltd. 39
Hailwood & Ackroyd Ltd. 58
Hampson Industries Ltd. 20
Harris, John, Tools Ltd. 32
Heatrae Ltd. 1
Heayberd, F. C., & Co. Ltd. 67
Hendrey Relays Ltd. 43
Henley's, W. T., Telegraph Works Co. Ltd. ..... Cover 4
Higgs Motors Ltd. 15
Howells (Electric Motors) Ltd. 57

Igranic Electric Co. Ltd. 60
International Combustion Ltd. 41

Jones, Samuel, & Co. Ltd. 79
Jones, Walter, & Co. (Engineers) Ltd. 72

Kaye, E. & E., Ltd. 44
Kersons Mfg. Co. Ltd. 81

Litholite Insulators & St. Albans Mouldings Ltd. 53
Londex Ltd. 98

Magnetic Devices Ltd. 71
Martindale Electric Co. Ltd. 67
Matthews & Yates Ltd. 23
Metafiltration Co. Ltd. 93
Metropolitan-Vickers Electrical Co. Ltd. ..... 48 & 78
Metway Electrical Industries Ltd. 16, 76 & 94
Midland Dynamo Co. Ltd. 76
Midland Electric Manufacturing Co. Ltd. 4
Midland Silicones Ltd. 61
Morris, John, Electrical Engineering Co. Ltd. 79
Mudie's Electrical Co. Ltd. 43

Nash & Thompson Ltd. 31
Neo Electrical Industries Ltd. 98
New Switchgear Construction Co. Ltd. 54
Newey & Eyre Ltd. 27

Parker Foundry (1929) Ltd. 56
Philips Electrical Ltd. 17
Plannair Ltd. 80
Purimachos Ltd. 96

Ratcliffe, F. S. 83
Record Electrical Co. Ltd. 46
Renold Chains Ltd. 55
Revo Electric Co. Ltd. 59
Robinson, Lionel, & Co. Ltd. 25
Rotax Ltd. 93
Rotunda Ltd. 8
Rowlands Electrical Accessories Ltd. 53
Runbaken Electrical Products 42

Salford Electrical Instruments Ltd. 16
Sanders, Wm., & Co. (Wednesbury) Ltd. 28
Sankey-Sheldon Ltd. 18
Savage Transformers Ltd. 96
Scemco Ltd. 75
Scholes, George H., & Co. Ltd. Cover 3
Siemens Brothers & Co. Ltd. 69
Simmonds & Stokes (Niphan) Ltd. 83
Smart & Brown (Engineers) Ltd. ... 68
Sperryn & Co. Ltd. 23
Statter, J. G., & Co. Ltd. 35
Sturtevant Engineering Co. Ltd. ... 7
Sun Electrical Co. Ltd. 10
Sutcliffe Speakman & Co. Ltd. 94

Taylor, Austin, Electrical Ltd. 82
Taylor Tunnicliff & Co. Ltd. 5
Thermostatic Controls Co. 72
Trumeter Co. Ltd. 42
Turnock, Geo., Ltd. 58

Universal Electrical Co. 72
Utilities (London) Ltd. 31

Varilectric Ltd. 80
V.G. Porcelain Co. Ltd. 23
Victoria Instruments 26

Ward & Goldstone Ltd. 22
Westinghouse Brake & Signal Co. Ltd. 73
Westminster Eng. Co. Ltd. 16
Whipp & Bourne Ltd. 8
Wholesale Fittings Co. Ltd. 95
Woden Transformer Co. Ltd. 26
Woods of Colchester Ltd. 85
Wootton & Co. Ltd. 19
Wright Electric Motors (Halifax) Ltd. 75

Yale & Towne Manufacturing Co... 74

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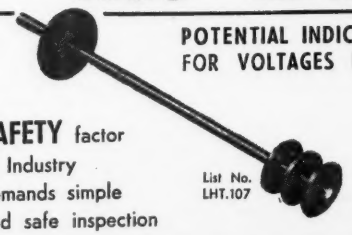

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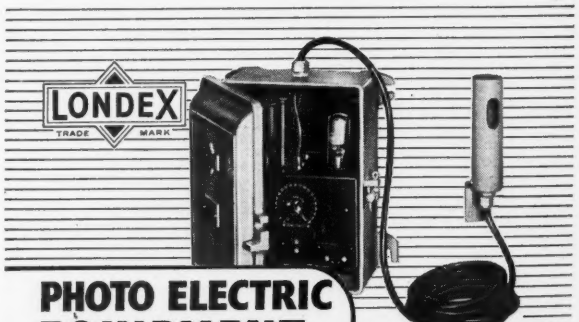

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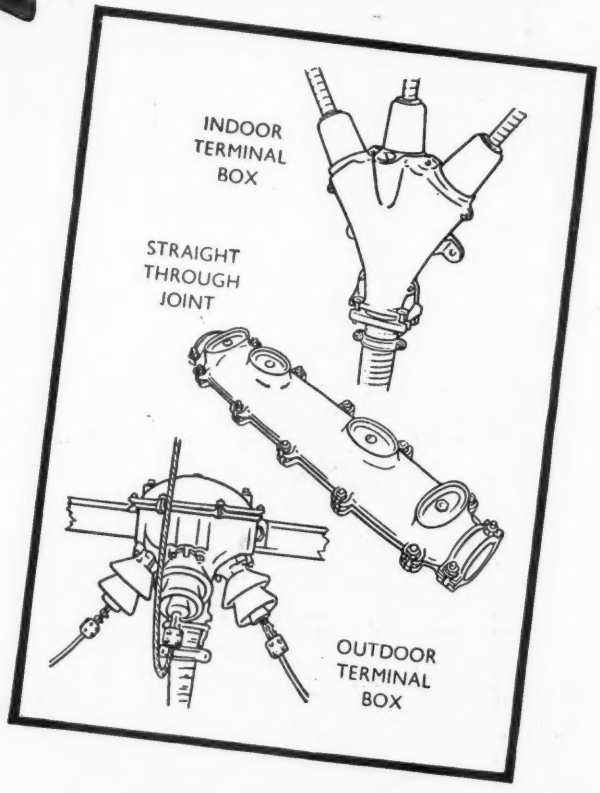

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ELECTRICAL REVIEW

Vol. 155

July - December, 1954

Eighty-Third Year of Publication

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

PUBLISHED WEEKLY ON FRIDAYS: PRICE ONE SHILLING

Editorial, Advertising and Publishing Offices : Dorset House, Stamford Street, London, S.E.1. Telegraphic Address : "Elecrev, Sedist, London." Code ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription : Home and Overseas £3 6s 0d. : U.S.A. and Canada $11.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

INDEX

Reference Table

PAGE	ISSUE	PAGE	ISSUE
1–40	2nd July	505–544	1st October
41–80	9th "	545–584	8th "
81–118	16th "	585–636	15th "
119–156	23rd "	637–674	22nd "
157–194	30th "	675–712	29th "
195–230	6th August	713–750	5th November
231–266	13th "	751–788	12th "
267–304	20th "	789–828	19th "
305–342	27th "	829–866	26th "
343–380	3rd September	867–906	3rd December
381–422	10th "	907–948	10th "
423–466	17th "	949–988	17th "
467–504	24th "	989–1026	24th "
		1027–1066	31st "

A.c. motor speeds, by " Rotor ", 203
Accidents: Factory Inspector's annual report, 24, 571; Compensation for, 108; —— on domestic premises, 656; Power station, 1014
Accounts, Payment at Post Offices of, 748; by " savings stamps ", 865
Adequate wiring, by J. I. Bernard, 587
Adhesives, by A. E. Williams, 955
Aerials, Broadcasting, 922
Agecroft power station extension, 229
Agricultural shows, 140, 217
Agriculture, Electricity in, by P. Wakeford, 869
Aircraft electrical equipment, 388; Vacation school in ——, 454; Inspection lighting, 1014
Airport, Telephone exchange at, 653
Albright & Wilson, New silicone plant of, 627
Alkali works inspector's report, 182
Alternators: Hydrogen-cooled ——, 660; Testing of ——, 950, 966, 1000
Altnabreac peat development scheme, 238
Aluminium Development Association: Directory of members, 102; New publications and films, 574
Aluminum Company of Canada: Kitimat scheme, first stage completed, 240
American standards, 661
Anglo-Norwegian telephone cable, 690
Apparatus for technical colleges, 433
Appleby-Frodingham Steel Co.: Pig iron production, 231, 254
Arc control devices, by W. A. McNeill and P. H. G. Crane, 41, 43, 89, 123
Argentina: New power line, 377; Hydro-electric schemes, 787; German telephones for ——, 896; Trade policy, 990
Artificial respiration, 282
Ash: Utilization of, 306; Objection to —— pumping, 503
Associated Electrical Industries: Offer for Siemens Bros. stock, 1028
Associated Ethyl Co., Motor control gear at works of, 320
Association of Electrical Machinery Trades: Annual general meeting, 21; Annual dinner-dance, 844
Association of Mining Electrical and Mechanical Engineers: Annual convention, 8
Association of Public Lighting Engineers: Annual conference, 391, 439, 482; Exhibition, 391, 528
Association of Short-Circuit Testing Authorities: New publications, 688
Association of Supervising Electrical Engineers: Exhibition, 528, 817; Presidential address, 700; Diploma scheme, 925
Atlantic telephone cable, 58
Atmospheric pollution, 265, 305, 313, 495, 623; Beaver Committee's report on ——, 867, 889; B.E.A. statement, 987
Atomic Energy Authority, 63, 216, 257, 529, 693, 1009, 1054
Atomic Energy Research Establishment, 257
Atomic power: Co-operation between Ministries, 16; Cost of, 77; False predictions on, 119; Siting of plants for, 153; Development of, 175; Training course, 529; Research team, 776; In Canada, 787; —— for New York, 865
Australia: Queensland plant extensions, 39; Electrical imports, 70; Exports, 102; Port Augusta power station inaugurated, 229; Muyang power station, 265; Snowy River project, 265, 314, 945; News from ——, 314; Electrical manufacture in, 356; Import policy, 364; Experimental wind power sites, 403; Traction equipment for, 454; Television, 454, 937; New works of C. A. Parsons & Co., 455; Import restrictions, 629; Infra-red equipment for, 693; Sydney County Council's annual report, 705; Switchgear for Yallourn power station, 777; Electrification for N.S.W. railways, 810; Cost of power in, 827; England to —— cable link, 865; Western —— Electricity Commissioner's annual report, 945; Development in Victoria, 946; Tariff inquiry, 976; Queensland hydro-electric plant, 1062
Austria: Hydro-electric development in, by R. E. Kaan, 207

Authors—

Alston, G. K., Industrial generation, 476
Ashton, A. L., Oil-filled cables, 547
Ballin, H. H., High bay lighting, 427
Barlow, Prof. H. E. M., Hall effect in semiconductors, 848
Barlow, S. L. M., Emerald Beach Hotel, 685
Beavis, C. J., Calcium carbide production, 808
Beeson, E. J. G., New mercury discharge lamp, 725
Bernard, J. I., Adequate wiring, 587
Beskine, J. M., Supergrid line construction, 469
Bird, James H., French water power, 49
Brooks, K. J. A., and R. H. Warring, Superconductivity, 995
Bruce, J. G., Traction motor maintenance, 758
Burniston, R. L., Silicone elastomers, 753
Cave, P. W., Paper insulated power cables, 312
Claydon, E. C., An early electrified farm, 845; Grain drying, 913
Cooper, B. K., Railway electrification—the driver's viewpoint, 1035
Cox, Sir Harold Roxbee, The W. M. Thornton Lecture, 8
Crane, P. H. G., and W. A. McNeill, Arc control devices, 41, 89
Cunnington, A., Domestic wiring, 997
Datta, Manoranjan, Earthing, 1019
Davies, D. R., The cross-jet bridge, 443
Dean, J. N., Insulation of underwater telephone cables, 911
Dollin, F., Steam turbine development, 737
Eccles, J., Power engineering in the future, 618
Ettinger, George M., Magnetic amplifiers, 348
Feltbower, B., Close speed control, 991
Flurscheim, C. H., Switchgear design, 317
Fowler, E. A., Trade discounts, 919
Gilbert, T. C., Farm installations, 67
Hancock, J. C., Protective tariff applications, 1055
Heather, T. W., Is fair trading worth while? 872
Heinrich, D. O., Large-scale electro-precipitation, 804
Hobbins, H., Maintaining domestic appliances, 615
Holmes, J. G., Lighting—the explosion hazard, 436
Jennings, R. E., Voltage stabilization, 315
Johnstone, W., and F. McLeish, High frequency electric induction furnaces, 677
Josephs, H. J., Unpublished work of Heaviside, 9
Kaan, R. E., Austrian hydro-electric development, 207; World electrical exports, 729
Laithwaite, E. R., and Prof. F. C. Williams, Brushless variable-speed induction motor, 925
Levey, G. W. S., Lighting in steelworks, 431
Lowe, A. S., Electrical Fair Trading Council, 797
Lyon, G., Power system analysis, 383
McLean, G. O., Rural distribution, 1057
McLeish, F., and W. Johnstone, High frequency electric induction furnaces, 677
McNeill, W. A., and P. H. G. Crane, Arc control devices, 41, 89
Madeley, S. T., Patents in 1953, 191
Matthews, C. F., T.V.A. under fire, 838
Mayson, C. F., Professional engineers, 189; Earthing faults on installations, 283; Legislative changes affecting contracts, 373
Miller, W. E., 21st National Radio Show, 321
Neville, S., Testing large synchronous machines, 1029
Palmer, A. M. F., Industry and the House, 17, 137, 213, 773, 809, 974
Payton, E. J., Boiler firing methods, 831
Ritchie, J., Overhead lines in Queensland, 295

Authors—*continued*
Robertson, A. T., Variable speed drives, 331
Roots, A. E., System reinforcement in Ayrshire, 644
" Rotor ", A.c. motor speeds, 203
Sewell, J. F., Steelmaking, 914
Sibley, E. H., Power factor re-examined, 273
Smillie, R., Factory electrical layouts, 951
Spencer, K. T., Fuel availability and efficient use, 1056
Sugden, F. E., Compensation for accidents, 108; Erection of plant, 1001
Taylor, W. T., Electric power transmission calculations, 125
Terroni, T. B. D., The Faraday Lecture, 908, 935
Thomson, A. G., Metals creepage, 183
Tucker, Margaret, The dearth of technologists, 353
Wakeford, P., Electricity in agriculture, 869
Walton, W. F., Storage space heaters, 553
Warring, R. H., and K. J. A. Brooks, Superconductivity, 995
Watlington, V., Order in the industry, 837
Webb, John, Forces between parallel electron streams, 1037
Weston, H. C., Lighting and productivity, 425
Williams, A. E., Adhesives, 955
Williams, Prof. F. C., and E. R. Laithwaite, Brushless variable - speed induction motor, 925
Wittrick, J. L., Reduction in motor sizes, 759
Automatic digital computation, 525
Automobile Association, Mobile radio scheme, 324
Avery, W. & T., New foundry of, 651
Ayrshire, System reinforcement in, by A. E. Roots, 644

BAGDAD Trade Fair, 402, 647–651, 818
Bankruptcies—
Aldis, L. W., 708
Alexander, R. C., 262
Anthony, L. J., 114
Barnett, J., and M. Barnett, 77
Boden, C. T., 984, 1024
Boydon, C. R., 944
Bullock, H., 77
Camden, R. J., 300, 670
Chapman, S. I., 632, 902
Clews, C. G., 174
Coaton, T. G., 114, 262, 376
Cooper, J., 746, 944
Crutchley, F. J., 376, 824
Cummings, A. J., and D. G. H. Hammerton, 902, 944
Daldry, H. W., 174
Digby, A. J., 746
Gannon, J. F., 462
Graham, G. S., 784
Hammerton, D. G. H., and A. J. Cummings, 902, 944
Hatton, M. J., 746
Hembrow, R. W., 1063
Hester, F. E. L., 784
Hobson, F. B. E., 300
Hooper, F. E. V., 152
Hugo, T. R., 376
Jager, A., 541, 824
Layton, W. J., 862
Leech, L. A. L., 670
Lock, F. R. A., and V. C. Lock, 944
Mack, J. L. R., 708
Marshall, E. T. M., 77, 152
Mason, W. H. T., 500, 632
Mayner, R. V., 746
Mellor, E. S., 152, 462
Milne, J. G., 944
Monk, F., 300, 376
Payne, A. C., 376, 462
Pountney, F. H., 632, 784
Quick, L. J., 632
Robbings, B. F., 1063
Roberts, R. H., 632
Rudd, K. G., 174
Schofield, H., 77
Searle, G. L., 152, 862, 984
Sharp, H. W., 500
Sharp, L. G., 500
Smith, B. T., 300, 670, 784
Tansey, H., 784, 1063
Thomas, P., 462, 670
Thompson, J. H., and H. A. Why, 541
Thorrington, H. F., 152, 376
Tilley, M., 262
Trevithick, J. H., 784
Trotman, D. A., 1024

Bankruptcies—*continued*
Turner, H., 824
Usher, M. C., 984
Vasey, E., 541
Watts, G. A., and G. H. Watts, 1063
Why, H. A., and J. H. Thompson, 541
Winslade, R. H., 862
Woolley, G. P., 500

Bann hydro-electric scheme, 748
Battelle Institute (U.S.A.): Nuclear energy research, 876
Batteries, Radioactive, 778
Battery manufacture, 233
Batti-Wallahs' Society, 60, 212, 573, 739, 895
B.B.C. Television Centre, White City, 23
Beaver Committee's report, 867, 889
Belfast Corporation Electricity Dept.: Annual report, 265; Power station extensions, 339; New power station, 635; District heating report called for, 896
Belfast power plant contracts, 529
Belgium: Survey of the railway electrification programme, 3; Imports and exports of, 246
Bhakra-Nangal project, 64
Bidston Dock, Transporters at, 541
Birlec, Furnace standardization by, 187; Acquisition by A.E.I., 528; Furnaces for India, 661, 978
Birmingham Corporation: Free travel dispute, 660, 969
Birmingham Corporation Bill, 147
Birmingham Electric Club, Golden jubilee of, 775
Blackpool: Illuminations, 187, 449
Blyth (Northumberland) power station, Proposal for, 377
Boiler breakdowns, 803
Boiler control, Automatic, 720
Boiler firing methods, by E. J. Payton, 831; 989
Boiler water treatment and testing, 106
Boilers, Outdoor, 714
Bold power station, 287
Bolton Training College, 1016
Borehole measurement, 810
Bowater Southern Paper Corporation, Tennessee mills of, 369
Bradford Colliery, winder installation at, 248
Brain, Examination of the, 220
Brazil: Electrification of, 81; World Power Conference in, 83; Power schemes, 247; Loans to State-owned enterprises, 275; Metropolitan-Vickers' factory in, 456; Generating sets for, 694; Progress in electrification, 918; Railway electrification in, 960
Brewers' and Allied Traders' Exhibition, 628
Bricks from power station ash, 352
Brighton trolley-bus decision, 569
Bristol, Storage heating in, 692
Bristol Aeroplane Co., Electrical installations of the, 145
Britannia, Electrical installation of, 165, 290
British Association for the Advancement of Science: Annual meeting, 247, 395, 479
British Broadcasting Corporation: White City television centre, 23; Annual report, 656; Contract for new equipment, 699; 1955 Handbook, 709; New Swansea transmitter, 1015; v.h.f. development, 1047
British Columbia: Power development scheme, 265
British Electrical and Allied Industries Research Association: Reports, 314, 527, 576, 684, 761, 796, 885; Current ratings for paper-insulated cables, 344; New Leatherhead laboratories, 675, 682; Wood pole tests, 684
British Electrical and Allied Manufacturers' Association: Contract price adjustment formulae, 175, 366, 492
British Electrical Development Association: Approved electrical appliances, 306; Lighting and road accidents, 329; Public speaking competitions, 572; New films, 628; Income tax relief leaflet, 663; Stand at Scarborough exhibition, 693; Stand at National Poultry Show, 893; Industrial Development Committee, 1010
British Electrical Power Convention: 1955 venue, 120
British Electricity Authority: Change of name, 13; Area Board sales; June, 153; July, 339; August, 502; September, 711; October, 865; November, 1062; Judgement on —— claim, 154; New collier launched, 193; Winter load shedding prospect, 196, 224; Water power plans, 229, 287, 543, 1007, 1022; Electricity-gas co-operation, 229; New loan, 268; River Avon overhead line, 287; Station superintendents' salaries, 288; Blyth power station proposal, 377; New plant, 382, 502; North Wales hydro-electric scheme, 394, 503; River Blyth overhead line, 417; Tilbury-Elstree overhead line, 469; Inquiry bureau, 492; " More Power " exhibition, 492; Objection to ash pumping, 503; Annual report, 505, 507–513, 565, 803, 809, 811; Birds and overhead lines, 521; Snowdonia water power scheme, 543; Area Boards' reports, 562, 573; Contracts placed, 660, 816, 933; Hydrogen-cooled alternators, 660; Objection to supergrid line, 660; Central workshops, 698; Publicity expenditure, 698; Supergrid route inquiry, 827; Domestic appliance sales, 830; Rural power plan, 898; Bankside building rates, 986; Statement on power station emissions, 987; British Oxygen Co. *v.* ——, 1013; Unfenced machinery prosecution, 1014
British Glass Industry Research Association, 663
British Guiana, Electricity in, 56
British Industries Fair: Re-organization of the London section, 176; Reduction in electrical exhibitors at, 907; Electrical Section committee members, 937
British Institution of Radio Engineers: Oxford convention, 19, 141, 158; Premium awards, 656; Annual report, 699; Presidential address, 739
British Insulated Callender's Cables: Aluminium sheathed cable, 492
British Insulated Callender's (Submarine Cables), 328
British Institute of Management conference, 699
British Iron and Steel Research Association: Steel for steam power plant, 284; Battersea laboratories, 693, 844
British Non-Ferrous Metals Association: Annual general meeting, 64; Operatives' course, 576
British North Greenland Expedition, 292
British Overseas Airways Corporation: Headquarters' telephone exchange, 653
British Oxygen Co. *v.* S.W. Scotland Electricity Board and B.E.A., 1013
British Productivity Council: Industrial engineering report, 438; Progress report, 528; Exhibition, 978, 1015
British Refrigeration Association: Meeting on safety codes, 693
British Road Federation: Booklet on heavy loads, 1013
British Standards Institution: Export Panel, 176; Annual report, 490; " Consumer Report," 492
British Standard Specifications: Boiler water treatment and testing, 106; Paper insulated cables, 281, 312, 344; Polythene insulated cables, 686; Graphical symbols, 700; Composite switch and fuse units, 736
British-Swedish Chamber of Commerce, 368
British Thomson-Houston Co.: Works visit, 149, 777; Rugby works, 269; " Lighting to Measure " booklet, 402; " Modern Streetlighting Practice " brochure, 740; Switchgear for Australia, 777; Trolley-buses for New Zealand, 778; New lighting showroom, 817; A.c. commutator motor booklet, 912; Large oil circuit breakers, 977; Aircraft inspection lighting, 1014; Lamp dispenser, 1016
British Trade Fair, Bagdad, 402
British Transport Commission's report, 638, 657; Freight charges scheme, 1051
British Welding Research Association: Annual report, 64
Brunswick Wharf power station, 635, 639
Brush Group: New company in Venezuela, 493; Management conference, 693; Film show, 740; Sale of tube well assets, 895
Brussels International Exhibition, 937
Building licences, End of, 752, 777
Building Research Station: Experiments with fly ash, 352
Burma: Generating sets for, 329, 493; Rural electrification, 529; Tariff increases, 694
Busbar distribution system, 291

CABLE leak detection, 1042
Cable Makers' Association: New publications, 574, 699

Cable ship, 248, 358, 657, 740
Cable works extension, 780
Cables: Monopolies Commission on, 232; New British standards for paper insulated ——, 281, 312; Submarine —— manufacture, 328, 877; —— standards, 344; Oil-filled ——, by A. L. Ashton, 547; —— contract conditions, 659; Cross-channel ——, 698; —— over railways, 853; England-Australia —— link, 865; Manufacture of Atlantic telephone ——, 877; Insulation of underwater telephone ——, by J. N. Dean, 911; Damage to H.V. ——, 1013; Oil-filled —— in Johannesburg, 1015; Overhead —— in Ulster, 1062
Cabril power station, Portugal, 212, 232, 258
Calcium carbide production, by C. J. Beavis, 808; 848
Cambois (Northumberland): Proposed power station inquiry, 865
Canada: British radio link for, 20; Dual-fuel engines for, 96; Power plant for, 100, 148; Radio-telephone order, 101; Electrical imports into, 117, 905; Imports and exports of, 178, 905; Power for industries in, 182; Branch businesses in, 215; Power for aluminium production in ——, 240; National Exhibition of ——, 251; Development in British Columbia, 265; Niagara station inaugurated, 287; St. Lawrence project, 287, 711; Oil shale investigation, 438; Athlone fellowships, 520; Toronto hydro-electric system, 543; Menihek Dam scheme, 583; Kitimat extension, 749; Under-water transmission cable, 749; Toronto trade fair, 783; Alberta development schemes, 787; Atomic generation, 787; Aluminium subway cars for, 818; Coast Mountains hydro-electric scheme, 827; Refrigerators, 896; Labrador power scheme, 908; Ontario Hydro-Electric Power Commission report, 1044
Canning, W., & Co., New Sheffield premises of, 148
Capacitors, Research on, 761
Capital in industry, 694
Carlisle station lighting, 572
Carmarthen Bay power station, 345, 387
Carshalton Technical Institute, 897
Catalogue exhibition, 627
Catering equipment for U.S. aircraft, 175
Catering Equipment Manufacturers' Association: Visit to Creda works, 662
Cathodic protection, Committee on, 968
Censuses, Industrial, 739
Ceylon: Electrical imports into, 821; Electricity costs in, 946
Chance Bros., New Smethwick offices, 177
Change-over contactors, 167
Charing Cross station, platform lighting, 583
Chelmsford Engineering Society lecture, 699
Chile: Extension scheme, 339
China: Trade experts visit Britain, 32, 96
Chloride Batteries: Exide convention, 60; Motor Show lunch, 693
Christie Hospital, New equipment at, 795
Churches, Electricity supplies to, 56
Circuit breaker arc control, by W. A. McNeill and P. H. G. Crane, 41, 43, 89
Circuit breakers: Performance of oil ——, 424; Unit testing of ——, 676, 688; Large oil ——, 977
Circuit reclosers, Automatic, 546, 570
City and Guilds Institute: Report of Department of Technology, 401; New publications, 401
Clyde Alloy Steel Co., New arc furnace at, 998
Coal: Future supplies of, 82, 713; Prices and supplies, 146; Prospects, 468; Foreign 468; Railway ——, 714; Supply position, 773
Coal-face conveyor control, 938
Coal washing plant order, 59
Coffee making equipment display, 218
Coils for the electrical industry, 1038
Colliery power consumption, 1028
Colombia: Hydro-electric project, 946
Colour-light signalling, 339
Colville: Steel plant power station contract, 147
Commercial Motor Show, 523
Compensation for accidents, by F. E. Sugden, 108
Conduit installation, Flexible, 190
Connah's Quay power station, 382, 457, 502
Consultative Councils, Electricity, 543, 711, 816
Contactor Switchgear, Wolverhampton factory of, 72
Contactors, Change-over, 167
Contract price adjustment formulae, 175, 366, 492, 662
Contracts, Legislative changes affecting, by C. F. Mayson, 373
Control gear, Automatic, 72
Conveyor system, overhead, 250
Cookers: Maintenance of, 268; Portable display stand for, 739; Special delivery vehicles for, 977; Sales drive in Scotland, 977
Cooking demonstrations, 124, 628, 818
Co-operative Societies, Electrical retailing by, 977
Copenhagen Trade Fair and Exhibition, 59
Copper Code, 101
Corran Works, Expansion of, 368
Coseley (Staffs), Street lighting at, 893
Cotswold line, Consent to, 175
Council homes, Supplies to, 986
Cranes, Stresses in electric, 874
Creep in metals, by A. G. Thomson, 183
Crompton Parkinson: Newport battery factory of, 233; Plant for Russia, 739
Cross-Channel power cable, 16
Cross-jet bridge, The, by D. R. Davies, 443
Crypton Equipment, New training school of, 818
Cuba, Market conditions in, 858
C.V.A. Jigs, Moulds & Tools, New factory of, 692
Cyprus, Trailer power set for, 148

DAIRY equipment test reports, 192
Dairy farm installation, 929
Dairy Show, 743
Damages award, 218
Dangerous Machines (Training of Young Persons) Order, 100
Decca Radar, 21, 22
Department of Scientific and Industrial Research: "Vehicle Headlighting Visibility," 454; Publication on selenium, 488; Tests on wood preservatives, 552; Dielectric properties of wood, 936; Audio frequency measurements, 960
Diesel Engine Users' Association: Report on oil engine performance, 990, 1012
Diesel engines: Small, 24; Report on —— performance, 990, 1012
Digital computors, 878
Dimplex, New London showrooms of, 1014
Dinsdale, F.: Transfer of undertaking to North Western Electricity Board, 377
Distribution control centre, New, 1039
District heating schemes, 16; 896
Dolphin, H.M.S., Submarine-escape training at, 719
Domestic appliance repair workshops, 575, 615
Domestic appliances: Tested, 177; —— of 60 years ago, 180, 245, 282; Maintaining ——, by H. Hobbins, 615
Domestic electrical equipment: Cookers, 276; Fires, 408; Low temperature heaters, 531, 628; Repair workshops for ——, 575; Survey of ——, 589–614, 662; Maintaining ——, by H. Hobbins, 615; Thermal storage water heaters, 664; Immersion heaters, 764; Washing machines, 880; Wash boilers, 1004
Domestic wiring, by A. Cunnington, 997
Donegal hydro and peat schemes, 503
Doors, Automatically operated, 938
Dorman, Long & Co., Lackenby steelworks, 197, 231
Drakelow "B" power station, 339
Drip feed gas carburizing, 624
Droitwich, All-electric flats at, 787
Dry shaver manufacture, 293
Dunsheath Committee's Report, 239
Durey, M. F., Londonderry Electricity Dept. *v.*, 827
Dussek Bitumen & Taroleum, Jubilee of, 976
Dynamo, Early, 830

EARTHING: ——and farm installations, 67; —— electrodes in collieries, 912; by Manoranjan Datta, 1019
Earthing faults on installations, by C. F. Mayson, 283
Earthing resistance, Large, 401
East Africa: Imports into, 1065
East Midlands Electricity Board: Identification of employees, 79; Distribution schemes, 109; Grain drying, 694
Eastern Electricity Board: Costs and tariffs, 56, 969; Water heating publicity campaign, 101; Mobile service centre, 292; Possible higher charges, 417; Flood restoration, 574; —— assists Ipswich Fire Brigade, 740; Consultative Council's meeting, 417, 787, 986; New consumers, 945; Finances of ——, 986; Supplies to Council homes, 986; Service Centre display competition, 1015
Edison Swan Electric Co: Cathode ray tube factory of, 22; Sunderland factory progress, 772
Education: Higher technological, 232, 957, 974; Dunsheath Committee's Report, 239
Egypt: Radar for the navy, 178; Prospects for British exports to, 816; Electrical imports into, 826
El Salvador, Telephones in, 827
Electric Construction Co.: South African factory, 627
Electric Lamp Manufacturers' Association: Illumination design course, 588
Electrical Association for Women: Autumn classes, 455; Awards, 456; One-day conferences, 572; 30th birthday of, 574; Scottish week-end conference, 646; English Electric demonstration, 738; Kitchen planning competition, 896; Hartlepools Branch jubilee luncheon, 938; New Beverley branch, 977
Electrical Contractors' Association: Trading by Electricity Boards criticized, 492; Year Book, 659; 1955 Conferences, 661; Co-operation with Electricity Boards, 868; Newcastle branch dinner, 973
Electrical Engineers' Exhibition, 528, 817, 859
Electrical Fair Trading Council, 215, 714, 724, 790; Historical survey, by A. S. Lowe, 797; Order in the industry, by V. Watlington, 837, 868, 872; "Coming-of-age" luncheon, 873
Electrical Fair Trading Policy, 215; Economic effects of, by T. W. Heather, 872
Electrical Industries Benevolent Association: Annual meeting, 251, 527; Annual dinner and ball, 814
Electrical Industries Club, 176
Electrical industry, Materials for, during 1954, 1048
Electrical Power Engineers' Association: West of England Branch annual dinner, 853, 887
Electrical progress—1954; C. A. Parsons & Co., 1003
Electrical Sign Manufacturers' Association: Design competition, 694, 1014
Electrical Wholesalers' Federation: Completion of forty years, 2, 27
Electricity, Municipal, 868
Electricity and transport, 638
Electricity Board for Northern Ireland: New headquarters for, 738
Electricity Boards' sales: June, 153; July, 339; August, 502; September, 711; October, 865; November, 1062; Annual reports, 562
Electricity Consultative Councils, 1028
Electricity Re-organization (Scotland) Bill, 138, 698, 772, 868, 894, 933
Electricity supply industry: Committee of Inquiry into, 259, 752, 854, 929, 975; Salaries in, 629, 810, 830, 854; Rising costs in, 963
Electronic instruments, Maintenance of, 980
Electronic production control, 790
Electronics Convention, 141
Electro-precipitation, Large scale, by D. O. Heinrich, 804
Emerald Beach Hotel, by S. L. M. Barlow, 685
Employment in 1953, 163
Enamelling plant, Mechanized, 895
Engineering, Industrial: Productivity team's report, 438, 545
Engineering Equipment Users' Association, 1064
Engineering in Europe, 61, 179, 221, 242, 272, 326, 362, 475, 726, 918, 965, 1002, 1034
Engineering Industries Association, Seventh Regional Display of, 662
Engineering materials, 381
Engineers, Professional, by C. F. Mayson, 189; —— and management, 853; Shortage of ——, 990
Engineers' Guild: Scottish branch, 177; Annual report, 858
English Electric Co.: New offices, 328; Protest over Seattle tenders, 492; Locomotives for New Zealand, 656; Demonstration, 738; American contract, 776; Liverpool works exhibition, 896

Equipment, Pre-packaging of, 367
Erection of plant, by F. E. Sugden, 1001
Ethiopia, Radio equipment for, 1014
European Atomic Energy Society, 257
European Management Conference, 217
Exe Valley extensions, 463
Exhibitions: Association of Public Lighting Engineers, 391; Bagdad Trade Fair, 402, 647–651, 818; Brewers' and Allied Traders', 628; Brussels International, 937; Canadian National, 251; Commercial Motor Show, 523; Dairy Show, 743; Engineering Industries Association, 662; Food Fair, 455; Instrument makers' travelling, 366; Laundry, 101; Model Engineer, 329; Motor Control Gear, 1051; Motor Show, 703; National Factory Equipment, 530; National Poultry Show, 893, 959; Nursing, 529, 663; "100 Good Catalogues," 627; Production, 115; Public Works, 843; Safety and Factory Efficiency, 628; Schoolboys', 1052; Scottish Industries, 399, 454; Smithfield Show, 958; Society of British Aircraft Constructors, 388; Willesden Civic Show, 493; "Working for Better Living," 978, 1015
Explosion hazard in lighting, by J. G. Holmes, 436
Export: Electrical —— prospects, by A. Newing, 202; —— licensing control, 629; Scientific instrument ——, 772
Exports, Electrical, 328, 330, 357, 661; World ——, by R. E. Kaan, 729
Eynsham-Yarnton overhead line, 635

FACTORY electrical layouts, by R. Smillie, 951
Factory Inspector's report, 24, 571
Fans, Mobile exhibition of, 367
Faraday House, 366; Annual dinner, 698
Faraday lecture, by T. B. D. Terroni, 908, 935
Farm, An early electrified, by E. C. Claydon, 845
Farm cottages, Supplies to, 543
Farm electrification, 440, 542, 938, 1052
Farm installations, by T. C. Gilbert, 67
Farming competition, 693
Farms, Electricity on, 99
Fatalities, 20, 217, 252, 361, 366, 447, 493, 652, 848
Federation of Associations of Specialists and Sub-Contractors, Annual luncheon of, 776
Federation of British Industries: India Supply Mission tenders, 368; Technical colleges and Industry Conference report, 492; Register of British Manufacturers, 819; New publications, 858
Feltham carnival, 573
Ferranti: Domestic heat pump, 564; Electronic research laboratories, 643; Agreement with Powers-Samas, 738
Films: Craftsmen Welders, 21; Industrial, 580; Owen Falls, 1013
Fire Research Board: Annual report, 55
Firedamp: Use as fuel, 382
Flexible conduit installation, 190
Floodlighting installations, Tennis, 21
Flood restoration, East coast, 574
Floor heating, Electric, 108, 121, 124, 424
Flow-line processes, 158
Flower pots, Cleaning machine for, 573
Fluorescent fittings, Interchangeable, 503
Fluorescent lamps: Improvements, 147, 176
Fly ash, Bricks from, 352; Utilization of, 945
Fog, Medical aspects of, 313; Analysis of ——, 506
Food, Maintaining temperature of hot, 937
Food Fair, 455
Food mixer production, 223
Forces between parallel electron streams, by John Webb, 1037
Foundry, New, 651
Fox, Samuel, & Co., New arc furnace at works of, 961
France: Montpezat hydro-electric scheme, by J. H. Bird, 48; Imports and exports of, 99; Railway electrification, 387; New electric locomotive, 571; Exchange of power with Spain, 787
Fuel, Removal of sulphur from, 734
Fuel and Power Statistical Digest, 1, 23
Fuel availability and efficient use, by K. T. Spencer, 1056
Fuel efficiency, Industrial, 195, 201, 251, 816, 1028, 1056
Fuel Research Board: 1953 Reports, 82, 111
Fuel supplies, 698
Fulbourn pumping station, 573
Fuller Electrical & Manufacturing Co.: Walthamstow factory extension, 801
Furnace standardization, 187
Furnaces: High frequency induction ——, by W. Johnstone and F. McLeish, 677; Corrosion resistant belt for, 705; New arc ——, 950, 961, 998; Induction —— for India, 978

GAIETY Theatre, New English Electric offices on site of, 328
Gas: —— and electricity in the North West, 39; —— Council's report, 637, 809; —— and electricity costs, 692; Competition between —— and electricity, 790
Gas carbonizing, Drip feed, 624
Gas and Electricity (Borrowing Powers) Bill: 82, 97, 138, 212
Gas-electricity choice, 1022
Gas turbines: —— in power stations, 99; Richardsons, Westgarth to make, 216; Atomizer performance, 684; Coal-burning ——, 758; Portable —— generator, 897
Gas washing, Cost of, 950
Gauge and Tool Makers' Association: Annual report, 401; Survey of apprentice training, 859; Hospital bed endowed, 895
General Electric Co.: Steel plant power station contract, 147; Semi-conductor laboratories, 307; Steelworks equipment contracts, 366, 817; Southend railway electrification contract, 488; Portsmouth refrigerator factory, 517; Household equipment showroom, 528; Infra-red equipment for Australia, 693; New sales aids, 694; Guildhall lighting fittings, 777; New lighting fittings showroom, 778; Paper mill plant contract, 858; Haiti telephone contract, 895; Coal-face conveyor control, 938; Alternator for Norway, 976; New Leeds premises, 1052
Generating plant programme, 830
Generating stations' output, Solid-fuel-fired, 82, 109
Generation: Private industrial, 145; Industrial ——, by G. K. Alston, 477; —— and distribution, 1027
Generation of electricity: June, 153; July, 288; August, 502; September, 660; October, 865; November, 1022
Generators: Export of, 99, 456; Portable gas turbine ——, 897
Geothermal steam and atomic energy, 229
Germanium diodes, Transistors and, 791
Germanium power rectification, 63
Germany: Electrical exports of West——, 301; Telephone contract for Argentina, 896
Gisla hydro-electric scheme, 1062
Glass Manufacturers' Federation: Annual meeting, 1059
Grain drying, by E. C. Claydon, 913
Grain drying equipment, 383, 694, 958
Gravel pumps for tin mining, 100
Great Yorkshire Show, 290
Greece: Extensions to St. George's Bay power station, 22
Grid suspension wiring installation, 978
Guildhall, Lighting of the, 777

HAITI telephone contract, 895
Hall effect in semi-conductors, by Prof. H. E. M. Barlow, 848
Hardman & Co., New premises of, 216
Harwell Isotope School, 1001
Heat pump, Domestic, 564
Heat transfer and thermodynamics, 923
Heating: Electric floor, 108, 121; Off-peak, 124, 424; Storage space ——, by W. F. Walton, 553; —— element temperatures, 830; Church —— booklet, 842; Advantages of electric ——, 934
Heating Appliances (Fireguards) Act, 973
Heaviside, Unpublished work of, by H. J. Josephs, 9
Heavy water nuclear reactor, 257
Hebrides, Electricity in the, 288
Henley's, W. T., Telegraph Works Co.: Student Manual, 1016
Herbert Committee, 259, 752, 854, 929
High bay lighting, by H. H. Ballin, 427
High frequencies, Measurements at, 890
High-frequency broadcasting, 99
High frequency electric induction furnaces, by W. Johnstone and F. McLeish, 677
Hire-purchase Bill, 51, 268
Hire-purchase finance, 328
Hire-purchase restrictions removed, 120, 143
Holidays-with-pay dispute, 215, 1013
Holland: British week at Maastricht, 21; Electrical market, 117; Netherlands electrical trade, 245; International Autumn Fair, Utrecht, 252; New Rotterdam power station, 711, 946; New Flushing power station, 865; Automatic telephony in, 987
Hoover: New Zealand company, 530; Window display contest, 819
Horticulture, Electricity in, 530; —— in the North-West, 999
Howden, James, & Co., Centenary of, 978
Hull telephone service jubilee, 994
Humphreys Joinery Works, Wiring installations at, 978
Hunts Bay (Jamaica) power station, 749
Hydro and thermal generation, 219
Hydro-electric development in Turkey, 1043

IBERIA, Lighting in the, 614
Illuminating Engineering Society: Presidential address, 653; Liverpool Centre—chairman's address, 700; Glasgow Centre meeting, 966
Illuminations, Seaside, 449
Imperial College of Science and Technology: Vacation school, 454, 524
Import Duties: Iron and Steel, 329
Impulse generator, 922
Income Tax, Electricity and, 663
Independent Television Authority, 493, 853
India: Bhakra-Nangal project, 64, 224; Import trade, 70; Railway electrification in, 132; Lamp standardization, 291; Electricity in, 292; Further industrialization, 329; Electricity production in, 339; Supply Mission, 368; Lamp tariff changes, 572; Melting furnaces for, 661; Lampholder tariff, 819; Gas cleaning plant for, 858; Industrial development in, 895; Brush Group sale of tube well assets, 895; Industrial Credit and Investment Corporation, 908, 1013; News from, 920; Electrical manufacture in, 921; Bombay Electricity Board, 946; Water power in Mysore, 946; Uttar Pradesh plant extensions, 946; Bombay transmission scheme, 986; Water power development in, 1022; Bombay power station, 1062
Indian Standards Institution: Standards for lamps, 291
Indication diagrams, Electrical, 106
Industrial Credit and Investment Corporation of India, 908, 1013
Industrial engineering: Productivity team's report, 438, 545; Terminology, 800
Industrial lighting, 423
Industry, Order in the, by V. Watlington, 837
Industry and the House, by A. M. F. Palmer, 17, 137, 213, 773, 809, 974
Infra-red paint drying, 1016
Installation inspection, 65
Installations, Earthing faults on, by C. F. Mayson, 283
Institute of Export: Annual dinner, 1023
Institute of Fuel: Inaugural conference, 430, 734; Rating dispute, 1013
Institute of Metals: Annual meeting, 147; Special general meeting, 398
Institute of Welding: Programme of annual meeting, 453
Institution of Civil Engineers: Annual conversazione, 12; Papers on radioactive wastes, 622
Institution of Electrical Engineers: Premiums, 15; Summer meeting, 28; Elections, 139; —— periodicals, 175; Wiring regulations, 232, 253; Officers for 1954–55 session, 359; Centre chairmen, 453, 522; Thermionic valve jubilee, 488; London meetings, 496; Benevolent Fund annual report, 560; Presidential address, 618; Radio Section chairman's address, 658; Measurements Section chairman's address, 658; North-Western Centre chairman's address, 659; Southern Centre chairman's address, 659; Cable contract conditions, 659; Utilization Section chairman's address, 676, 687; Supply Section chairman's address, 687; Radio and Measurements Section joint meeting, 763, 800; Membership list, 763; Mersey and North Wales Centre annual dinner, 775; Irish Branch chairman's address, 848; North Midland Centre annual dinner, 857; Benevolent Fund appeal, 973

Institution of Heating and Ventilating Engineers: Examinations of, 442
Institution of Mechanical Engineers: Presidential address, 700; Parsons Memorial Lecture, 737
International Aeradio, New Southall premises of, 58
International Electro-technical Commission: Jubilee celebrations, 92, 468; Philadelphia meeting, 488, 514, 556, 619
Iraq: Electrical imports into, 1052
Ireland, Republic of: Rural electrification campaign, 344; Fuel and power resources, 363; Electrical imports into, 584
Irish Electricity Supply Board: New headquarters for, 339; Annual report, 363; Hire-purchase agreement, 367; Hydro and peat schemes, 503; Accident to employee, 652; Peat power station, 945; Turf-fired power stations, 1062
Iron and Steel Scrap Order, 938
Isle of Harris hydro-electric scheme, 339
Isle of Man: Douglas Corporation Electricity Dept. report, 265; Electricity Board—Douglas Corporation power exchange agreement, 1022
Italy: Large waterwheel alternators in, 79; Television equipment for, 401; —— to Sicily transmission line, 968

JAMAICA: Hunts Bay power station, 749
Japan: Power supply in, 265; Imports from, 938; Electrical machinery manufacture in, 1017; Electricity generation in, 1062
Jersey: Television service, 22; 6·6 kV overhead line, 897; Electric cooking campaign, 1062
Joint consultation: Progress in electricity supply industry, 344, 364; N.J.A.C. report, 364
Jointing, Overhead line, 22
Junior Institution of Engineers: New headquarters of, 513; Presidential address, 966

KARIBA and Kafue hydro-electric schemes, 19
Kent County Show, 140
Kenwood Electrics: Mobile demonstration unit, 178; Food mixer works of, 223; German contract, 367
Kerry's (Great Britain), Domestic appliance exhibition at, 573
Kidbrooke School, Installation at, 237, 290, 492
Kidderminster, Earth leakage trips in council houses at, 711
Kiln, New electric, 967
Kirkcaldy, All-electric flats at, 400
Kitchen control unit, Special, 692
Kitchen, Demonstration, 529, 976; Miniature, 778
Kitimat aluminium project, 240, 749
Koepe winder, Bradford Colliery, at, 248
Korea, Generating sets for, 663
Kuwait, New street lighting fittings for, 821

LAMP making machinery, 494
Lamp publicity, 356, 441, 1016
Lancashire, Development in north-east, 291
Lancashire Dynamo & Crypto Co.: Trafford Park works fire, 218
Lasham pumping station, 688
Latin-American trade, 1052
Laundry Exhibition, 101
Laurence Scott & Electromotors, Factory extension of, 859; Contract from Atomic Energy Authority, 1009

Letters to the Editor—
America, Learning from, by "Ex-Electrical Engineer and Manager", 886
Applicants, Treatment of, by "Still Hopeful", 799
Arc control devices, by C. E. R. Bruce, 168; by W. A. McNeill, 168
Cables, Submarine, by D. S. Young, 928
Channel Islands, Radio and television in the, by W. K. Allen, 98
Charges for service, by L. H. G. Handley, 886
Commercial or domestic ?, by E. Luscott, 763
Comparative transport charges, by F. K. Farrell, 513; by G. H. Warne, 646
Consumers' deposits, by Leslie Maynard, 847, 975; by W. H. Warhurst, 887
Consumers' money boxes, by J. Harley, 735

Letters to the Editor—*continued*
Contactor contacts, Maintaining, by E. Jackson, 624
Cross-jet bridge, The, by G. Caton, 513; by D. R. Davies, 624
Different outlooks, by R. C. Golding, 798
Domestic heating, by H. K. Whitehorn, 18; by A. C. Hazel, 18, 55, 214; by A. J. Mare, 129; by G. H. Buckle, 129
Earth leakage protection, by C. R. Jack, 569
Earth leakage trips, by R. J. Baker, 689
Earthing in domestic premises, by J. Griffiths, 569
Earthing methods, by J. A. Winchester, 130, 452; by T. C. Gilbert, 214, 491
Elderly engineers, by G. W. Williamson, 491
Electrical Engineers' Exhibition, by P. A. Thorogood, 975
Engineering qualifications, by "One of Many", 55
Floor heating, Electric, by S. Nevens, 297
"Hot line" working, by M. C. Morley, 624
Isle of Man, Interference in the, by T. H. Colebourn, 18
Kuwait lighting contract, by R. B. Greenwood, 886
Lampholder troubles, by D. Revington, 19; by J. A. C. Kendle, 19; by Michael Neidle, 98
"Landlords'" services, by C. B. Faulconbridge, 799
Load, Optimum, by "Load Factor", 18; —— factor, by J. F. Mackenzie, 55
London Board appointment, by "E.W.", 975; by H. J. Randall, 1012
Maintaining contactor contacts, by E. Jackson, 624
Nimmo, The late Mr. H., by J. A. Hill, 928
Oil-filled cable leakages, by J. H. Morgan, 800; by A. L. Ashton, 928
Optimum load, by "Load Factor", 18
Plugs, Round and flat-pin, by C. L. Arnold, 19
Qualifications, by "Disillusioned", 130
Railway electrification, by M. W. Broom, 689; by V. G. Merritt, 736, 886; by F. K. Farrell, 800
Refrigerator guarantees, by "Caveat Emptor", 451; by T. Whittaker, 569
Reversing earth and neutral, by F. Cooper, 624; by J. Samson, 689; by P. H. Rochefort, 762
Rubber, Anti-static, for medical use, by E. O. Muller, 762; by R. W. Holt, 886
Social service, by W. J. Bennett, 247; by T. L. Franklin, 297
Standard frequency transmissions, by R. S. J. Spilsbury, 928
Storage space heaters, by Eric Bates, 646; by R. Croft, 646, 847; by B. Gill, 646; by A. C. Hazel, 735; by C. J. Wheeler, 735; by A. Goodman, 846; by E. M. Ackery, 847; by L. G. A. Sims and K. R. Sturley, 928
Submarine cables, by D. S. Young, 928
Tariffs, Variations in industrial, by J. E. Herbert, 168
Technologists, Dearth of, by W. K. Brasher, 407; by "Observer", 407
Tramways, The case for, by F. K. Farrell, 690, 762; by G. H. Warne, 736; by E. Johns, 762; by E. H. Jesty, 762
Transport charges, Comparative, by F. K. Farrell, 513; by G. H. Warne, 646
Transport in Greater London, by H. S. Trinder, 847
Variable speed a.c. drives, by K. B. Blake, 407; by A. T. Robertson, 451, 763; by T. White, 735
Wholesalers and retailers, by J. M. Hawkins, 491
Who were the makers ?, by John M. Fraser, 887
Wind-pump conversion, by G. Lan, 847
Women electrical engineers, by "J.S.", 130

Light-current developments, 980
Lighting: "—— to Measure", 402; Street ——, 417; Association of Public —— Engineers' exhibition, 391; Industrial ——, 423; —— and productivity, by H. C. Weston, 425; High bay ——, by H. H. Ballin, 427; —— in steelworks, by G. W. S. Levey, 431; Modern ——, 434; Explosion hazard in ——, by J. G. Holmes, 436; Association of Public —— Engineers' Conference, 439, 482; Approved street —— columns, 522; Carlisle station, 572; Charing Cross station ——, 583; —— in S.S. *Iberia*, 614; "Lumenated" ceiling, 692; Tunnel excavation ——, 692; Fluorescent —— at Luton, 711; New mercury discharge lamp, by E. J. G. Beeson, 725, 819; New street —— fittings for Kuwait, 821; Coseley street —— installation, 893; International design competition, 896; —— for production, 897; Public ——, 990; Wembley tender complaints, 1013; Aircraft inspection ——, 1014; Stage ——, 1041
Linear accelerator, 524

Liquidations—
Articair Refrigerators, 300
Bassett, Edmund, & Son, 902
B.C.R. Installations, 376
Betterway Electrical Products, 174
Brocks Refrigeration, 300
County Electronics, 300
Cox's Radio & Electrical Co., 862
Eastwood Radio, 541
Edolite Lamps, 300
Electric Cables, 746
Electrical Developments Co. (Chester), 632
Electronics (Liversedge), 632
Electro-plant, 338
Franks, George, & Co. (Guildford), 902
G. & W. Components, 580
Gilson, D., & Co., 746
Gornall, H. J., & Co., 746
Hattons (Billingham), 300
Hockley Electric Motor & Engineering Co., 862
Hodgkins, Wm., & Co., 300
Hunt & Co. (Newark), 670
Lancaster Electric Co. (Enfield), 338
Lincoln & Egerston, 984
Lines, A. W., 708
Mayfield Electrics, 746
Micox Electrical Equipment, 77
M.M.J. Radio & Television Co., 632
Peco (Electrical Contractors), 77
Phillips Electrical Supplies, 174
Premier Electric Services, 174
Rogers & Hall, 632
Scott, G. R., & Co., 902
Shearman, F. W., 77
Smith & Forshaw, 300
S.R.M. Television, 300

Lister, R. A., & Co.: Small diesel engine of, 24; Generator set contract, 366
Liverpool: Street lighting conversion, 503
Liverpool University: Synchro-cyclotron at, 59
Load factor, 586, 816
Loch Luichart power station, 287, 417
London County Council: New tender conditions, 714
London Electricity Board: Window dressing competition, 291; Request for assisted wiring scheme, 827; Lewisham substation inquiry, 898
London Transport Executive: Metropolitan line signalling, 339
Londonderry Electricity Dept. *v.* M. F. Durey, 827
"Lumenated" ceiling, 692

MACHINERY imports, Duty-free, 186
Magnet, Laboratory, 1054
Magnetic amplifiers, by G. M. Ettinger, 348
Malaya, Electrical imports into, 932
Management, Industrial, 1015
Manchester Association of Engineers: President's inaugural address, 576
Marchwood power station, 87, 463, 492
Marconi's Wireless Telegraph Co.: B.B.C. contract, 699; Training college, 738; Transmitter for Belgium, 858; Radio equipment for Ethiopia, 1014
Mass production, 120
Materials for the electrical industry, 1048
M. & C. Switchgear: Extension to Kelvinside works, 59
Measurement conference, 201
Measurements, Precision electrical, 875, 1011; —— at high frequencies, 890; Audio frequency ——, 960
Measuring instruments, Servicing electronic, 980
Mechanical Engineering Research Laboratory, 923
Medway College of Technology, 450
Menihek Dam hydro-electric scheme, 583
Mercury discharge lamp, New, by E. J. G. Beeson, 725
Mersey Cable Works, New building of, 780

Merseyside and North Wales Electricity Board: New farm supplies, 109; Request for stamp scheme, 865
Merseyside Electrical Lighting Services Committee, 487
Metal Industries Group, New Bromborough factory planned, 572
Metals, Mechanism of phase transformations in, 111
Metals creepage, by A. G. Thomson, 183
Meter assembly, 979
Meters, Report on outside, 986
Methane: Use as fuel, 382
Metropolitan-Vickers Electrical Co.: Training professional engineers, 60; Traction equipment contract, 454; New Brazil factory, 456; Generators for Norway, 693; Apprentices' club, 817; Infra-red paint drying equipment, 1016
Mexico: Trade with, 291; Patla hydro-electric plant, 583; Equipment preferences in, 1012
Middle East trade, 638
Middle East Trade Mission, 895
Middlesbrough: Wiring contract, 20
Midlands Electricity Board: Street lighting tariff, 109; Catering equipment showroom, 329; Automatic recloser demonstration, 546, 570; Fixed charge assessment protest, 565 Mains costs for new houses, 731, 748; Gloucestershire rural programme, 827; Cooker sales agreement with E.C.A., 893; Meter reading cost, 898; Electric tool exhibition, 937; Dudley system modernization, 945; Ocker Hill distribution control centre, 1039
Mid-Wessex Water Co., Lasham pumping station, 688
Miners' lamps: Bulb testing, 58; West African contract, 818
Mines: Mechanics and electricians in, 446; Coal-face conveyor control, 938
Ministry of Fuel and Power: Memorandum on coal mine regulations, 446
Ministry of Materials, 147
Ministry of Transport and Civil Aviation: Rear lamps and reflectors Order, 401; Approved street lighting columns, 522
Mirrlees, Bickerton & Day: Burmese order for generating sets, 329; Generators for Korea, 663
Mobile service centre, 292
Mobile showrooms, 251
Model Engineer Exhibition, 329
Modern electric home, The, 589-609, 662
Monopolies Commission, 232, 973, 977, 1013
Morris Commercial Cars: Busbar system at factory of, 291
Motor, High voltage submersible, 693
Motor, Variable speed induction, by Prof. F. C. Williams and E. R. Laithwaite, 925, 966
Motor control gear installation, 320; —— exhibition, 1051
Motor Show, 703
Motor sizes, Reduction in, by J. L. Wittrick, 759
Motor speeds, A.c., by " Rotor ", 203
Motors: Close speed control of, by B. Feltbower, 991; Maintenance of traction, by J. G. Bruce, 758, 812, 897; U.S. market for electric, 854
Munroe, E., South Eastern Electricity Board *v.*, 251

NATIONAL Coal Board: Publication on earthing electrodes, 912
National Display Convention, 628
National Factory Equipment Exhibition, 530
National Industrial Fuel Efficiency Service, 195, 201, 251
National Joint Advisory Council, Report of, 364
National Physical Laboratory: Control Mechanisms and Electronics Division, 100; Symposium on automatic digital computation, 525; Symposium on precision electrical measurements, 875
National Poultry Show, 893, 959
National Radio Show, 306; by W. E. Miller, 321
National Research Development Corporation: Steam-operated prime mover development, 701
National Register of Electrical Installation Contractors: Annual general meeting, 19
National Smoke Abatement Society conference, 455
National Union of Mineworkers: Annual conference, 82
Nelius, s.s., 758
Nestor, s.s., 758

New Books—
A.B.C. Goods Transport Guide, 379
Basic Principles in Electrical Engineering, by I. H. Child, 164
B.B.C. Handbook, 709
British Standards Yearbook, 358
CABMA Register, 26
Colliery Year Book and Coal Trades Directory, 59
Concise History of Mathematics, by Dirk J. Struik, 88
Crystal Rectifiers and Transistors, by M. G. Say and E. Molloy, 208
Design and Analysis of Industrial Experiments, edited by O. L. Davies, 241
Driver's Handbook for C Licence-Holders, 978
Editorial Publicity, by D. K. Winslow, 114
Electrical Contractors' Year Book, 659
Electrical Ignition Equipment, by F. G. Spreadbury, 723
Electrical Measuring Instrument Practice, by E. H. W. Banner, 335
Electrical Who's Who, 416
Electricity Undertakings of the World, 739
Electricity Undertakings in Natal, 940
Electromagnetic Field in its Engineering Aspects, by G. W. Carter, 335
Electronics, by A. T. Starr, 88
F.B.I. Register, 819
Ferromagnetic Domains, by K. H. Stewart, 723
Fleming, Sir Ambrose, A biography of, by Prof. J. T. MacGregor-Morris, 857
Fundamentals of Electrical Engineering, by Edward Hughes, 940
Glass Reinforced Plastics, edited by Philip Morgan, 723
Indian Electrical Year Book, 330
Introductory Circuit Theory, by E. A. Guillemin, 208
Ironmonger Directory of Branded Hardware, 190
Laplace Transforms for Electrical Engineers, by B. J. Starkey, 241
Light and Lighting Directory of Manufacturers, 573
Lighting for Color and Form, by R. G. Williams, 940
Mathematics in Action, by O. G. Sutton, 164
Modern Electroplating, by A. G. Gray, 208
Oscilloscope at Work, by A. Haas and R. W. Hallows, 241
Power System Transients, Ed. by E. Openshaw Taylor, 335
Principles of Mass and Flow Production, by F. G. Woollard, 241
Problems in Electrical Engineering, by S. Parker Smith, 701
Radio Laboratory Handbook, by M. G. Scroggie, 723
Radio Valve Data: Characteristics of 2,000 Valves and C.R. Tubes, 701
Raw Materials for Electric Cables, by A. King and V. H. Wentworth, 164
Repair of the Small Electric Motor, by K. Wilkinson, 416, 491
Royal Society of Arts Journal, 1942–52 Index for, 514
Transient Analysis of Alternating Current Machinery, by Waldo V. Lyon, 940
Whitaker's Almanack, 977

New Electrical Equipment—
Air-break control gear, 673
Air drying unit, 1061
Airer, Towel, 927
Alternators, High-frequency, 855; Range of, 926
Ammeter, Differential, 341
Automatic generating plant, 785
Balancing machines, 577, 629
Battery, Commercial vehicle, 785
Bearings, Dry, 981
Bell transformer, 263
Blankets, Electric, 727, 981
Boiler house instrument, 927
Boiler washer, 188
Brazing machine, Fine wire, 1021
Cable diameter gauge, 289
Cables, Insulated, 110
Calculators, Electrical, 1021
Capacitors, Silvered mica, 727
Carburizing quality measurement instrument, 227
Circuit breaker, Earth leakage, 379

New Electrical Equipment—*continued*
Clamp for flush switches, 33
Coffee percolator, 1061
Coffee service, 785
Coils, High-Q, 577
Conduit, Flexible, 33; Plastic-covered, 71
Connectors, Solderless wire, 727; Multiway, 927
Console heater, 1061
Control gear, Air break, 673
Conveyor, Hinged boom, 144
Cooking control, Automatic, 497
Counter tube, High speed, 927
Cutouts, Automatic, 1021
Decorative lighting set, 728
Defroster, Water pipe, 673
Differential ammeter, 341
Dishwasher, Domestic, 673
Drill units, Mining, 227
Dry bearings, 981
Dry shavers, 71, 855
Dryer, Tumbler type, 727
Earphones, Induction, 927
Earth continuity tester, 263
Earth leakage circuit breaker, 379
Earth leakage protective device, 379
Electroluminescent panels, 289
Electronic motor controller, 577
Electronic test meter, 577
Electrostatic detector, 497
Farrowing unit, Wooden, 727
Fires, Fuel effect, 728
Fluorescent fittings, 341, 855
Fluorescent handlamps, 1060
Fluorescent lamp starter, 227
Fluorescent lighting equipment, Portable, 1060
Furnaces, Metal processing, 379
Fuses, Insulated service, 33
Geared motor units, 341, 981
Generating sets, 341, 785
Glass, Diffuse reflection, 926
Greenhouse heater, 1061
Hair dryers, 728, 1021
Handlamps, Fluorescent, 1060
Heaters: Immersion, 341; Infra-red, 577, 926; Pipe, 673; Tubular, 926; Radiant panel, 926; Safety, 1060; Console, 1061; Greenhouse, 1061; Piano, 1061
Heating elements, Silicon carbide, 379
Heating panel, Radiant, 263; Infra-red, 926
High-bay lighting unit, 785
High-Q coils, 577
Immersion heaters, 341
Industrial stethoscope, 263
Infra-red heaters, 577, 926
Instrument, Carburizing quality measurement, 227
Instruments, Measuring, 341, 981
Irons, Electric, 227, 820, 855
Kettles, Electric, 33; Car type, 820
Lamp, Mobile surgical, 341; Signalling, 727; Adjustable, 728
Lamps, Miniature, 33
Lantern: Sodium " cut-off," 263; Street lighting, 728
Lighting equipment, Portable fluorescent, 1060
Lighting fittings, 110, 497, 785, 855
Lighting set, Decorative, 728
Liquid level switch, 927
Long scale ohmmeter, 673
Mercury switch relay, 188
Metal processing furnaces, 379
Mining drill units, 227
Motor controller, Electronic, 577
Motor starter, Direct switching, 926
Motors: F.h.p., 71, 577; Geared units, 341, 981
Ohmmeter, Long scale, 673
Oil switch, 144
Oscillograph, Stylus, 820
Oscilloscope, Measuring, 1060
Panels, Electroluminescent, 289
Piano heater, 1061
Pig farrowing unit, Infra-red, 727
Pipe heater, 673
Plateswitches, 110
Plating control indicator, 926
Plug, Adjustable, 263
Potato peeler, 379
Potentiometers, Precision, 855
Pouch, Travel iron, 728
Process time delay switch, 110
Psophometer, 785
Radiant heating panel, 263
Recorder, Miniature chart type, 728
Refrigerators, Domestic, 188, 1060
Regulator, Three-phase, 1021

New Electrical Equipment—*continued*
Relay: Motor protective, 144; Mercury switch, 188; Miniature, 577; Small, 785
Rural type transformers, 289
Safety heater, 1060
Shavers, Dry, 71, 855
Shop window lighting fitting, 289
Signalling lamp, 727
Silicon carbide heating elements, 379
Sockets, Bracket fixing, 71
Sodium "cut-off" lantern, 263
Soldering iron, Low voltage, 144
Soldering iron accessories, 110
Spectrometer, Infra-red, 71
Spot welding machine, 497
Spray plant, 981
Stackers, Battery electric, 188
Starter, Direct switching motor, 926
Stethoscope, Industrial, 263
Street lighting lantern, 728
Stroboscope, Industrial, 497
Surgical lamp, 341
Switches, Process time delay, 110; Plate, 110; Oil, 144; Liquid level, 927
Switchgear, Flameproof, 71
Tapper, Portable electric, 227
Temperature control equipment, 1061
Test meter, Electronic, 577
Tester, Portable tool, 110; Earth continuity, 263
Thermostat, Watertight, 1021
Thickness gauge, Ultrasonic, 820
Time delay interlocking device, 1061
Tool tester, Portable, 110
Towel airer, 927
Transformers: Bell, 263, Rural type, 289; Variable output, 820; Low frequency, 981; Welding, 1060
Travel iron pouch, 728
Trunking, Medium duty, 820; Inverted, 981
Tubular heaters, Flameproof and horticultural, 926
Tumbler dryer, 727
Voltage stabilizer, 1021
Water pipe defroster, 673
Welder, Spot, 497
Welding transformer, 1060
Wire connectors, Solderless, 727
Wool carding control equipment, 927
Worm reducer unit, 289

New Zealand: Rectifiers for, 59; Roxburgh hydro-electric scheme, 206; Motor duty, 216; Geothermal steam bores, 229; Clutha river diverted, 407; Power demand forecast, 417; New Hoover company, 530; South Island progress, 543; Wellington transport service, 583; Diesel-electric locomotives for, 656; Rimutaka tunnel, 692; Auckland trolley-buses, 778; Duty on motors, 896; Water power in, 1050
Niagara (Ontario) hydro-electric station, 287
Nigeria: Electricity Corporation report, 749
North East Electrical Club, 663
North East Essex Technical College, 561
North Eastern Electricity Board: Network modernization, 39; Low voltage complaint, 543; Supplies to smallholdings, 711; Load shedding warning, 898
North of Scotland Hydro-Electric Board: First Luichart set started, 39; Caithness "power from peat" experiment, 232, 238; Conon Valley development, 287, 787; South Angus distribution scheme, 288; Wind power experiments, 306; Isle of Harris scheme, 339; Ullapool power station, 339; Submarine cable laid, 398; Loch Luichart and Ullapool stations inaugurated, 417; Radio link with maintenance gangs, 748; Fort Augustus-Speyside overhead line, 898; Plant for Carolina Port power station, 898; Mobile radio in the Highlands, 945; Progress in Northern Area, 945; Cooker sales campaign, 977; Torr Achilty power station, 1022; Caithness supply cost, 1047; Gisla hydro-electric scheme, 1062
North Wales Hydro-Electric Power Bill, 1022
North Wales water power, 394, 1022
North-West, Rural supplies in, 715
North Western Electricity Board: Exhibit at Royal Lancashire Show, 329; Transfer of small undertaking to ——, 377; Sale (Cheshire) substation, 543; Rural supplies in the north-west, 715; Window display competition, 858; Cumberland rural supplies, 865; Cooker sales agreement with E.C.A., 893; Report on outside meters, 986; Albert Square substation, 987; Horticultural experiments, 999
Northern Ireland Electricity Board: Annual report, 7; Overhead cables, 1062
Northumberland, Rural supplies in, 339
Norway: Bergen-Oslo railway electrification, 212; Imports and exports, 454; Aberdeen-Bergen telephone cable, 690; Generators for, 693
Nuclear energy research, 876
Nuclear reactors, 777
Nursing Exhibition, 529, 663

OBITUARY—
Allcock, W., 327
Alldread, F. T., 814
Bacon, E. F., 245
Barber, W. L., 286
Barker, Harold, 932
Bellamy, A. V., 1009
Bennett, D. J., 15
Boys, E., 733
Bray, E. N., 697
Cargill, D. S., 286
Colbran, J. B., 892
Colebrook, F. M., 15
Colgrain, Lord, 772
Collins, C. B., 136
Constable, A. D., 814
Cook, A., 626
Cooper, A. B., 516
Cridge, A. J., 327
Cummins, C. J., 245
Dain, Major G. R., 245
Davies, C. F., 171
de Paula, F. R. M., 1009
Dixon, H., 286
Dobson, Dr. J. H., 54
Dove, W. E. B., 15
Dunfoy, W. P., 487
Dyson, J., 406
Erickson, A. E., 136
Farrar, G., 211
Finch, R. H., 772
Foulds, H., 1047
Fountain, E. T., 626
Frank, E. J., 814
Furniss, W. M. B., 772, 972
Ginman, A. H., 814
Givens, E. C., 171
Goodman, W. H., 487
Grace, George E., 892
Graham, J. T., 972
Grime, R. E., 772
Hammond, J. J., 733
Hargreaves, H. V. F., 655
Hills, Thomas R., 892
Hippisley, E. T., 972
Hodgson, W. G., 697
Holloway, F. H., 327
Hoover, H. W., 487
Horsfall, W. M., 932
Howarth, O. J. R., 15
Hunter, T. C., 54
Ireland, J. J., 655
Isherwood, F., 655
Kennedy, Sir John, 406
Kent, C. S., 211
Lane, L. H., 626
Lea, R. H. M., 972
Leonard, H. W., 626
Lister, T. F., 136
Lucking, E. P., 972
Lumsden, J. H., 852
McBride, F. R., 892
McCready, Christopher, 852
MacRory, R. V., 733
Mirrey, J., 54
Montagnon, Dr. E. L., 487
Moore, R. E., 211
Moulton, J. E., 626
Nicholls, F., 1047
Nimmo, H., 697, 772
Nixon, L. R., 15
Ockenden, F. E. J., 244
Orange, W. J., 286
Paul, G. C., 96
Payne, J. H., 516
Peaker, J. F., 245
Petter, Sir Ernest W., 136
Pinder, P. M., 568
Pistor, D. R. A., 516
Ramage, G. S., 932
Rea, Hon. J. R., 286
Scourfield, W. B., 733
Selkirk, A. A., 892

Obituary—*continued*
Sharp, E. E., 972
Simpson, Sir Maurice G., 54
Simpson, W., 54
Smith, Fred, 814
Smith, H. A., 245
Solomon, M., 406
Souter, J. S., 286
Stevens, Theodore, 697
Stevens, W. C., 697
Stewart, C. L. E., 852
Stirling, A. J., 733
Thomson, F. G., 697
Turnbull, C., 406
Wall, L., 568
Walton, J., 655
Wears, J. H., 853
Webb, J., 516
White, H. A., 932
Whitehead, J. B., 853
Williams, A. E., 892
Williams, Sir Herbert, 171
Wilson, P. H., 171
Woodfield, F. W., 361
Young, J. M., 487

Ocker Hill distribution control centre, 1039
Oerlikon Engineering Co.: High-power testing station, Zurich, 31
Oil circuit breaker arc control, by W. A. McNeill and P. H. G. Crane, 41, 43, 89
Oil engine performance, 990, 1012
Oil-filled cables, by A. L. Ashton, 547
Oil firing of power stations, 751
Oil shale investigation, 438
Oldham & Son: Annual Motor Show dinner, 739; West African contract, 818
Ontario's power resources, 1044
Organization for European Economic Co-operation, 2; Survey of power station plant, 659; "Price of Electricity" report, 1012
Output of solid-fuel-fired stations, 82, 109
Overhead line jointing, 22
Overseas electrical trade, 25, 185, 357, 489, 702, 856, 1053
Owen Falls Construction Co., 456
Owen Falls hydro-electric scheme, 635; Colour film of, 1013
Oxford Street, New traffic signals in, 894

PACKING research centre, 574
Pakistan: Imports control, 215
Pantechnicon for washing machines, 529
Paper insulated cables, New British Standard for, by P. W. Cave, 312
Paper mill plant, Contract for, 858
Paper mills, Bowaters' Tennessee, 369
Parliament, Industry and, by A. M. F. Palmer, 17, 137, 213
Parliamentary report, 698, 772, 816, 853, 894, 973, 1010, 1047
Parsons, Sir Charles: Centenary, 19
Parsons, C. A., & Co.: New Australian works of, 455; Rotor for Canada, 939; 1954 manufacturing activities of, 1003
Parsons Memorial Lecture, 737
Patents in 1953, by S. T. Madeley, 191
Patla (Mexico) hydro-electric plant, 583
Peat in power stations, Use of, 22, 232, 238, 874, 987
Penang, Electrical plant for, 147
Per unit system of power transmission calculations, by W. T. Taylor, 125
Persia: Exports to, 246; Trade with ——, 306
Persian Gulf: Electricity in Qatar, 66
Peru, Radio equipment for, 976
Philadelphia power station, 459
Philips Electrical, New Bristol premises of, 959; New X-ray centre, 895
Pig Iron Production: Appleby-Frodingham Steel Co., 254
Pinkston power station, 986
Plant, Erection of, by F. E. Sugden, 1001
Plessey Co.: New Swindon factory, 58
Pollution: Power stations and, 153; Atmospheric ——, 265, 305, 313, 495, 623, 868, 889; B.E.A. statement, 987
Portugal: Cabril power station, 212, 232, 258; Hydro-electric schemes, 288; New power distribution company, 1062
Post Office: Trunk call traffic, 368; Research station, work of, 520
Poultry appliances, Improved, 328
Power engineering in the future, by J. Eccles, 618
Power factor correction, 2; 340
Power factor re-examined, by E. H. Sibley, 273

Power plant, Rapid starting of, 12
Power station construction costs, 506
Power station emissions, 987
Power station plant, O.E.E.C. survey of, 659
Power station sites: Richborough (Kent), 816
Power stations, Turf-fired, 1062
Power stations: Marchwood, 87, 463, 492; Rye House, 131; Rogerstone, 193; Cabril (Portugal), 212, 232, 258; Niagara (Ontario), 287; Loch Luichart, 287, 417; Bold, 287; Drakelow "B", 339; Belfast, 339; Ullapool, 339, 417; Carmarthen Bay, 345, 387, 660, 898; Connah's Quay, 382, 457, 502; Philadelphia, 459; Brunswick Wharf, 635, 639; Skelton Grange, 635, 676, 680, 898; Pretoria, 748; Hunts Bay (Jamaica), 749; Brighton "B", 787; Staythorpe, 827; Cambois inquiry, 865; Flushing (Holland), 865; Carolina Port, 898; Pinkston, 986; Stella North 1013; Torr Achilty (Scotland), 1022
Power system analysis, by G. Lyon, 383
Powers-Samas: Agreement with Ferranti, 738
Price questions, 157
Price tribunal, 99
Prime mover, Steam operated, 701
Production comparisons, Western Europe, 1028
Production Exhibition, 115
Productivity, Lighting and, by H. C. Weston, 425
Professional engineers, by C. F. Mayson, 189
Protective tariff applications, by J. C. Hancock, 1055
Public transport: Fares in London and Glasgow, 382; —— Association annual dinner, 808
Public Works Exhibition, 843
Pullars Instruments, New Brighton factory of, 694
Pumped-storage installations, 724
Pumping station, New, 573; Electrification of ——, 865; Additional supply to ——, 865
Pumps: Gravel —— for tin mining, 100; Centrifugal, 737
Purchase tax: Blanket covers, 938; Cathode-ray tubes, 1010
Purchasing Officers' Association, Annual conference of, 530; "Minibition", 663

QATAR, Electricity in, 66
Queensland, Overhead lines in, 295

RADAR for Egyptian navy, 178
Radio: Point-to-point —— services, 22; —— trade code, 58; Importing of —— valves, 26; National —— Show, 306; Automobile Association's mobile —— scheme, 324; Standard frequency —— transmissions, 763, 800; Broadcasting in Wales, 853; Communication transmitter for Belgium, 858; Broadcasting aerials, 922; Mobile —— in Highlands, 945; Equipment for Ethiopia, 1014; New Swansea transmitter, 1015; v.h.f. development, 1047
Radio Show, National, 306; By W. E. Miller, 321
Radioactive wastes, 622
Radiotherapy, New equipment for, 795
Railway electricians' claim, 252
Railway electrification: Belgian, 3; London-Tilbury line, 56; Turkish, 265; French, 387, 571, 807; Manchester-Sheffield line, 424, 878, 936, 986, 1045; Need for further ——, 467; Southend line contracts, 488, 776; Glasgow scheme, 488, 698; Spanish, 524; Transport Commission's report, 657; New South Wales, 810; Future British plans, 853; Southend line, 879; Thanet line, 894; Brazilian, 960; Engine driver's viewpoint, by B. K. Cooper, 1035
Railways: Push button shunting, 402; Automatic train control, 473; Platform lighting, 583; Train-initiated announcements, 690; Battery locomotives suggestion, 698; Thirsk derailment report, 734; Reorganization scheme, 737, 773; Push-button signalling, 748; Proposed new tube ——, 876; Shenfield-Chelmsford signalling, 896; Signalling equipment for South Africa, 937; British —— freight charges, 1051
Rear lamps and reflectors, 401
Recorder, c.s., completion of, 248; In collision, 358; Description of, 657; Searchlights on, 740
Rectifiers: —— for New Zealand, 59; Germanium type, 63; Mercury arc —— in boiler control equipment, 720
Refrigerators: Manufacture of, 517; Safety codes for, 693; —— for Canada, 896
Remington Rand: Glasgow factory of, 293

Reports and Dividends—
Aberdare Cables (Holdings), 541, 984
Aerialite, 862, 1024
Aiton & Co., 174
Anglo-American Telegraph Co., 708
Anglo-American Vulcanized Fibre Co., 708
Associated British Engineering, 984
Associated Electrical Industries, 462, 1063
Automatic Telephone & Electric Co., 338
Avery, W. & T., 36, 784
Babcock & Wilcox, 632
Bakelite, 708, 746
Bennis Combustion, 500
Berry's Electric, 420, 500
British Aluminium Co., 580
British Electric Resistance Co., 824, 1063
British Electric Traction Co., 500, 708
British Electric Transformer Co., 746
British Electricity Authority, 300
British Insulated Callender's Cables, 984
British Oxygen Co., 462
British Relay Wireless & Television, 500
British Thermostat Co., 420, 462
Broadcast Relay Services, 174, 984
Brook Motors, 376, 862, 944
Brotherhood, Peter, 580
Brown Brothers & Co., 376
Brown, John, & Co., 902
Bruce Peebles & Co., 862
Brush Group, 784
Burco, 784, 862
Cable & Wireless, 300
Cable & Wireless (Holdings), 376
Cables Investment Trust, 226
Calcutta Electric Supply Corporation, 632
Calcutta Tramways Co., 262
Canning, W., & Co., 746
Cape Electric Tramways (1949), 338
Chloride Electrical Storage Co., 420, 500, 541, 580
Christy Bros., 338
Clarke, T., & Co., 784
Cohen, George, Sons & Co., 114, 462, 708
Cole, E.K., 36, 152, 262, 376, 500, 708
Contactor Switchgear, 708, 862
Cossor, A. C., 420, 540
Crabtree Electrical Industries, 708, 1063
Crompton Parkinson, 746, 862
De La Rue, Thomas, & Co., 36, 824
Desoutter Bros. (Holdings), 376
Dewhurst & Partner, 902
Dictograph Telephones, 902
Dowty Group, 902
Drake & Gorham, 36, 114
Dubilier Condenser Co., 226, 500
East African Power & Lighting Co., 300, 420, 708
Ebonite Container Co., 174, 580
Electric Construction Co., 36, 114, 500
Electric Furnace Co., 174, 420, 862, 984
Electric & General Investment Co., 114
Electric & Musical Industries, 708, 862
Electrical Apparatus Co., 670, 824
Electrical Components, 152, 300
Enfield Cables, 944
Enfield Rolling Mills, 862
Engineering & Lighting Equipment Co., 36, 114, 670
English Electric Co., 262, 944
Ericsson Telephones, 632
Ever Ready (Gt. Britain), 708
Ever Ready Trust Co., 708, 944
Eveready South Africa, 500
Falk, Stadelmann & Co., 262, 784, 902
Ferranti, 36
Gabriel, Wade & English, 262
General Cable Manufacturing Co., 862
General Electric Co., 174, 226, 540
Globe Telegraph & Trust, 226, 784
Greengate & Irwell Rubber Co., 670
Hackbridge Cable Holdings, 376, 540
Hackbridge & Hewittic Electric Co., 36, 76, 944
Hall, J. & E., 338
Heenan & Froude, 784, 1024
Henley's, W. T., Telegraph Works Co., 541
Hick, Hargreaves & Co., 76, 226, 944
Holophane, 632, 708
Hoover, 152, 300
Hopkins, G., & Sons, 670
Hopkinsons, 708
Howden, James, & Co., 174, 300, 500
Hunt, A. H. (Capacitors), 462
International Combustion (Holdings), 462
Jerusalem Electric & Public Service Corporation, 708, 746, 862
Johnson, Matthey & Co., 76, 902
Johnson & Phillips, 174, 824
Johnson, Richard & Nephew, 36, 824
Kent, George, 152, 338, 984
Lancashire Dynamo Holdings, 376
Laurence, Scott & Electromotors, 862
Lightalloys, 632
Lightfoot Refrigeration, 76, 226
London Electric Wire Co. & Smiths, 670
London Electrical & General Trust, 300, 902
Lucas, Joseph (Industries), 824, 1024
Marco Refrigerators, 36, 1024
Marconi International Marine Communication Co., 632, 670
Marryatt & Scott Holdings, 36, 114
Mather & Platt, 174
Metal Industries, 300
Meters, 784
Midland Electric Manufacturing Co., 746, 902
Morgan Crucible Co., 36, 114
Morphy-Richards, 580, 746
Murex, 174, 1063
Newman & Watson, 300
Newton Bros. (Derby), 338, 376, 632
Nico Light Engineering Co., 338, 420
Nigerian Electricity Supply Corporation, 174, 338, 500
North of Scotland Hydro-Electric Board, 746
Oldham & Son, 262
Oriental Telephone & Electric Co., 76, 944, 1024
Palestine Electric Corporation, 462, 540, 670
Parmiter, Hope & Sugden, 174, 262, 376, 420, 984
Perak River Hydro-Electric Power Co., 632, 784
Permali, 76, 541, 632
Peto Scott Electrical Instruments, 746, 984
Phoenix Telephone & Electric Holdings, 114, 420
Pinchin, Johnson & Associates, 338, 984
Pirelli-General Cable Works, 226
Plessey Co., 824, 984
Pye, 36, 76, 152, 338, 944, 1024
Pyrotenax, 862
Radio & Television Trust, 746, 984
Radio Rentals, 1063
Rawlings Bros., 902
Reliance - Clifton Cables & Industrial Products, 36, 152, 670
Renold & Coventry Chain Co., 36
Revo Electric Co., 76, 902
Reyrolle, A., & Co., 462
Richardsons, Westgarth & Co., 174, 500
Rothermel Corporation, 76
Ruston & Hornsby, 114
Scottish Cables, 944
Scottish Cables (South Africa), 541, 824
Siemens Bros. & Co., 902
Simon-Carves, 152
Smith, S., & Sons (England), 824, 1024
Sterling Cable Co., 376
Stone, J. & F., Lighting & Radio, 670, 784
Stone, Max, 984
Stothert & Pitt, 580, 784
Strand Electric Holdings, 462, 708
Stream-Line Filters, 338, 462
Sturtevant Engineering Co., 541
Sun Electrical Co., 862
Telegraph Condenser Co., 420
Telegraph Construction & Maintenance Co., 76, 300
Telephone & General Trust, 541
Telephone Manufacturing Co., 824
Telephone Properties, 300, 376, 670
Telephone Rentals, 1024
Thompson, John, 300
Thorn Electrical Industries, 174, 226, 376, 500
Tube Investments, 784, 824
Turner & Newall, 944, 1063
Ultra Electric (Holdings), 420, 632, 746
Vactric, 226, 1024
Venner, 708
Vent-Axia, 36, 984
Walsall Conduits, 76, 420
Ward & Goldstone, 76, 152, 784
Ward, Thos., 670
Watford Electric & Manufacturing Co., 670
Waygood-Otis, 984
Weir, G. & J., 784
West London & Provincial Electric & General Trust, 376

Reports and Dividends—*continued*
Westinghouse Brake & Signal Co., 1063
Worthington-Simpson, 114
Yarrow & Co., 784

Research Association of British Rubber Manufacturers, New headquarters of, 899
Retail and service trades statistics, 158, 163
Revo Electric Co., Demonstration kitchen of, 529; Mechanized enamelling plant, 895
Reyrolle, A., & Co., New conveyor system at, 250
Reyrolle Research Station: Explosion, 100
Rheidol hydro-electric scheme, 229, 287, 394, 503
River Avon overhead line, 287
Roads, Accidents on, 424; Heavy loads by, 1013
Rogerstone power station, 193
Royal Chartered Colleges of Technology, 176
Royal Fine Art Commission: Twelfth report, 37
Royal Highland Show, 37
Royal Lancashire Show, 329
Royal Show, Windsor, 103
Royal Society of Arts: L. B. Atkinson memorial lecture, 911
Royal Welsh Show, 217
Royal Yacht *Britannia*, 165, 290
Rubber research, New laboratories for, 899
Rural distribution, by G. O. McLean, 1057
Rural electrification, 109, 546, 827, 898
Rural supplies in the north-west, 715, 865
Russia: Atomic power in, 54; Orders from, 290, 330, 739
Rye House power station, 131

SAFETY and Factory Efficiency Exhibition, 628
Safety in substations, 16
St. Bartholomew's Hospital: New linear accelerator, 524
St. Lawrence River power project, 287, 711
Salaries: Electrical officials', 177; Station superintendents', 288; Electricity supply industry, 629, 810, 830, 854
Salesmanship training, 149
Salter, Geo. & Co.: Pre-packaging of equipment, 367
Salvi Co. of Milan: Overhead line jointing, 22
Sanders, Wm., & Co., Fire at works of, 816
Saxonia, Telephone system for, 60; Batteries for, 401
School installation: Kidbrooke, 237, 290, 492
Schoolboys' Exhibition, 1052
Scientific Instrument Manufacturers' Association: Travelling exhibition, 366; "Electronics at Work" exhibition, 478
Scientific Policy, Report of Advisory Council on, 452
Scotland: All-electric flats, 400; Hydro-electric stations inaugurated, 417; Glasgow railway electrification scheme, 488, 698; New Ferranti research laboratories, 643; Glasgow power station extension, 986; Rural supplies in south-west ——, 1010
Scottish Industries Exhibition, 399, 454
Searchlights, Cable ship's, 740
Selenium: Substitutes, 468; Facts about, 488
Semi-conductors: Laboratories of General Electric Co., 307
Service centres: Mobile, 251, 292; Window-dressing competitions, 251, 292, 1015
Sewage pumping station, New, 730
Sewage works charges, 986
Shepcote Lane Rolling Mills, New plant at, 871
Shift work, 738
Shin tunnel project: Radiators for, 401
Showrooms: Mobile, 251; Machine tool, 290; Early closing of, 543; Contractors', 586; Lighting, 817; New Bristol —— of Philips Electrical, 859; All-electric kitchen ——, 976; Dimplex, 1014
Shunting, Push-button, 402
Siemens Bros. & Co.: A.E.I. offer for stock, 1028
Sign design competition, 1014
Signalling, Push-button, 748
Signs, Illuminated, 819, 1007
Silicone elastomers, by R. L. Burniston, 753
Silicone plant, British, 627
Simplex Electric Co.: Creda works visit, 662; Cooker display stand, 739
Sims, F. D.: Ramsbottom works' extension, 217
Skelton Grange power station, 635, 676, 680
Slotted angle bar, 939
Smith Meters, Dunblane factory of, 979
Smith's English Clocks: London showrooms, 218
Smithfield Show, 958
Smoke abatement conference, 178
Smoke pollution, 99
Snowdonia water power scheme, 543
Snowy River hydro-electric project, 265, 314, 945
Society of British Aircraft Constructors exhibition, 388
Society of Non-Destructive Inspection, Formation of, 858.
South Africa: Overseas economic survey, 100; Geared motors for, 217; Market Report, 246; Cape Town Electricity Dept. report, 303; News from, 313, 1033; Earthing resistance for, 401; Electricity Supply Commission's annual report, 442; Electric Construction Co.'s factory, 627; Import policy, 662; Pretoria power station, 748; Tariff on motors, 776; Plant for Johannesburg, 827; Electrical trade of, 863; Railway signalling equipment for, 937; trade prospects, 950; Trade with, 964; Oil-filled cables in Johannesburg, 1015; Turbo-generator for Bloemfontein, 1052; Tariff application, 1052
South America: Sir George Nelson's tour, 48
South Angus distribution scheme, 288
South of Scotland Electricity Board, 196, 933
South East Scotland Electricity Board: Border rural supplies, 153; Capital expenditure of, 229; Stand at World Poultry Congress, 328, 367; Supplies in Northumberland, 339; Aluminium sheathed cable for, 492; All-electric flats proposals, 748; Oxenfoord Castle floodlighting, 827
South Eastern Electricity Board: Sussex County Show exhibit, 124; —— and Corporation contracts, 147; New showrooms, 154; Hire purchase terms, 193; —— *v.* E. Munroe, 251; Early-closing of showrooms, 282; Domestic appliance repairs, 575, by H. Hobbins, 615; Broadstairs change-over, 787; Teachers' conference, 937
South Wales Electricity Board: Tariff review, 193; Damages award against the, 218
South West Scotland Electricity Board: Terms for rural supplies, 79; Water heater hire, 79; System reinforcement in Ayrshire, by A. E. Roots, 644; Cable contract, 978; Rural supplies position, 1010; British Oxygen Co. *v.* ——, 1013
South Western Electricity Board: Improving Minehead supply, 39; Slogan competition, 147; Mobile showrooms, 251; Compensation for injury, 290; Exe Valley extensions, 463; Finances of, 573; Woodcote substation, 583; Flood damage repairs, 894; River Fal underwater line, 898
Southern Cross: Public address equipment, 101
Southern Electricity Board: Tariff modification, 39; Early-closing of showrooms, 153, 282; Cookery demonstrations, 628; Dairy farm installation, 929
Southern Rhodesia: Kariba and Kafue hydro-electric schemes, 19; Trade Commissioner, 528
Southport flower show, 177, 361
Soviet bloc, Exports to, 661
Space heaters, Storage, by W. F. Walton, 553; in Bristol, 692
Spain: Railway electrification, 524; Exchange of power with France, 787; Barcelona power plan, 1022
Speed control, Close, by B. Feltbower, 991
Sports Turf Research Institute: Frost protection experiments, 895
Staff, Technical, 868
Stage lighting, 1041
Standard Telephones and Cables: Southampton cable factory, 178; New impulse generator, 922
Standards, International, 468
Star Aluminium Co., Floor warming installation at works of, 108
Starting of power plant, Rapid, 12
Staythorpe power station: Transformer for, 27; Objection to extensions, 39, 287; Proposed cooling towers, 827
Steam, High temperature, in ships, 758
Steam and power survey, 1, 23
Steam stations, Oil firing of, 751
Steel: Electricity and ——, 231, 254; —— for steam plant, 268, 284; Heat-treating stainless ——, 871; —— control, 894
Steelmaking, by J. F. Sewell, 914
Steelworks: Expansion 197; Equipment for —— 366, 817; Lighting in ——, by G. W. S. Levey 431; Large arc furnace in, 961
Strategic Goods (Control) Order, 977
Street cleansing tests, 839
Strikes: J. Lyons & Co., 13, 20, 147, 169, 176, 216, 232, 250; —— condemned, 424; Siemens Brothers & Co., 456; Port of London, 492
Submarine cable laying, 398
Submarine-escape training, 719
Substation control equipment, 377
Substations, Safety in, 16
Sulphur: Removal from fuel 734; Recovery of, 790
Sunbeam Electric Co.: Scottish factory, 56
Sunderland: Tramway abandonment, 109, 651
Superconductivity, by K. J. A. Brooks and R. H. Warring, 995
Supergrid: Transformers for the, 101, 216; Tower for Staythorpe-Drakelow line, 288; Tilbury-Elstree section, 469; Objection to —— line, 660; Gloucestershire section, 772; Route inquiry, 827; Route approved, 865
Supervisors, Training of, 148
Sussex County Show, 140
Sweden; Kilforsen plant inaugurated, 79; Conditions in, 303
Switchgear design, by C. H. Flurscheim, 317
Switchgear production, 72
Switzerland: Oerlikon high-power testing station, 31; Power supply in, 249; Mountain railway equipment, 473; Rheinau power plant, 1007; 1953 Electrical exports, 1020
Synchronous machines, Testing large, by S. Neville, 1029

TARIFF applications, Protective, by J. C. Hancock, 1055
Tasmania, Power supply in, 107
Technical colleges: Apparatus for, 433; N.E. Essex, 561; Carshalton, 897; Equipment at Wednesbury, 908
Technical courses, 248
Technological education: Memorandum on ——, 232; Higher ——, 957, 974
Technologists, Dearth of, by Margaret Tucker, 353; Shortage of ——, 343, 407, 468, 714, 949, 990
Technology: Royal Chartered Colleges of, 176; Medway College of, 450
Tees-Side Railless Traction Board, 633
Telecommunications, Engineering and Manufacturing Association: Annual dinner, 699
Telecommunications research, 520
Telephone cables: Atlantic, 58, 724, 774, 877; Anglo-Norwegian, 690; Insulation of submarine ——, by J. N. Dean, 911
Telephones: Installations of, 99; Number of, 101, 529; Development, 212; At London Airport, 653; —— in El Salvador, 827; Haiti contract, 895; Gale damage to, 973; Automatic —— in Holland, 987; Hull undertaking jubilee, 994
Television: Jersey —— service, 23; White City —— Centre, 23; North Hessary Tor —— station, 355; Equipment for Italy, 401; —— detection, 430; In Australia, 454, 937; Independent Television Authority, 493; Compatibility in colour ——, 724; Rowbridge transmitter inaugurated, 808; Proposed suppressor regulations, 973; Commercial —— frequencies, 1010
Television Bill, 56, 213
Tendering procedure, 328, 714
Tenders, "All-in", 752; Reading house wiring, 817
Tennessee Valley Authority under fire, by C. F. Matthews, 838
Tennis floodlighting installation, 21
Terminology, Industrial, 800
Testing Heavy Plant, 268, 269
Thermionic valve, Jubilee of the, 488, 564, 790, 830, 840-842, 857
Thermodynamics, Heat transfer and, 923
Thomson & Brown Bros., New Inverness premises of, 937
Thornton Lecture, 8
Traction motor maintenance, by J. G. Bruce, 758, 812, 897
Trade discounts, by E. A. Fowler, 919
Trades Union Congress: General Council's annual report, 355; Brighton meeting, 465

Traffic signals, New installation of, 894
Train control, Automatic, 473
Train-initiated announcements, 690
Training school, Automobile test equipment, 818
Tramways: Tees-Side profit from, 633; Sunderland's abandonment of, 109, 651
Transformers (Watford), New factory extension of, 739
Transformers: Supergrid, 101; Silicone insulated, 250; Manufacture of large ——, 801; Large —— for power stations, 945
Transistors, Course on, 102; —— and germanium diodes, 791
Transmission calculations, Electric power, by W. T. Taylor, 125
Transmission lines: 66 kV, 417; 132 kV, 635, 898; 6·6 kV, 897; 11 kV underwater, 898; Italy-Sicily ——, 968; Combined h.v. and l.v. ——, 1047
Transmission of power, 2; Under-water cable, 749
Transporters, Dock, 541
Trinidad: Electricity Commission's annual report, 945
Trolley-buses: Wolverhampton profit, 543; Support for London ——, 711, 748; Auckland, 778; South Shields profit, 946
Tunisia: Quotas for British goods, 290
Tunnel excavation lighting, 692
Turbine, Instructional water, 819
Turbine development, Steam, 737
Turbine-shaft distortion, 836
Turbo-alternator end-windings, 966, 1000
Turbovisory equipment, 888
Turf, Protection against frost of, 895
Turf-fired power station, 1062
Turkey: Electric railways in, 265; Hydro-electric development in, 1043
T.V.A. under fire, by C. F. Matthews, 838
Tyneside Productivity Committee: 120

UGANDA Electricity Board: Crossing the Nile by rocket, 78; Film of Owen Falls scheme, 1013
Uganda-Kenya power link, 39
Uganda Radio and Electrical Association, 211
Ullapool power station, 339; Inaugurated, 417
UNESCO: Inventories of apparatus for science teaching, 433
" Unipede " Congress, 924
United Nations Economic Commission: Electric Power Sub-Committee's Tokyo meeting, 671
United States: Arkansas overhead line protests, 13; Dam contracts, 20, 56, 572, 776; Trade with, 216; Generator set contract, 366; Philadelphia power station, 459; Electrical exports of, 568; Buying policy, 638; Electrical standards, 661; Power dispute settled, 787; Market for electric motors, 859; Atomic power for New York, 865; Import policy, 1028; River Rouge plant, 1062

VALVES, Importing of radio, 26
Variable speed a.c. drives, by A. T. Robertson, 331
Vegetable wastes as fuel, 220
Vehicle headlight dazzle, 454
Venezuela: New hydro-electric project, 377; Brush Group in, 493
V.h.f. broadcasting, 175, 212
" Visible " heat, 2
Voltage stabilization, by R. E. Jennings, 315

WAGES: Cable making industry, 176; Electricians' holiday, 196; Scottish electricians, 216, 738; National Railway Union, 252; Engineering, 267, 290, 627, 776, 990, 1013; Post Office engineers, 367, 1010; Plumber jointers, 528; Scientific workers, 1051
Wales: Rural electricity in, 16; Hydro-electric schemes, 287, 394, 503, 543
Washing machines, Purchase of, 79; Pantechnicon for, 529
Water power in New Zealand, 1050
Wednesbury Technical College, Installation at, 909
Welding demonstration room, 1051
West Hull & Haltemprice Joint Main Drainage Scheme, New pumping station of, 730
Westinghouse Brake & Signal Co.: Rectifier Division convention, 149
Wiggin, Henry, & Co., Zenith works jubilee, 778
Willesden Civic Show, 493
Wilson, John, (Gildersome), Automatic door installation at premises of, 938
Wind power experiments, 306, 403
Wind tunnel drive, 69
Winder at Bradford Colliery, 248
Window displays, Christmas, 1015
Wire goods, Marking of imported, 147
Wiring, Adequate, by J. I. Bernard, 587
Wiring, Assisted, 827
Wiring, Domestic, by A. Cunnington, 997
Wiring regulations, I.E.E., 232, 253
Wood: Tests on preservatives, 552; Dielectric properties of, 936
Wood pole tests, 684
Woods of Colchester: Mobile fan exhibition, 367
" Working for Better Living " exhibition, 978, 1015
World electrical exports, by R. E. Kaan, 729
World Poultry Congress, 328, 367
World Power Conference, 69, 81, 83-87, 159, 219

X-RAY apparatus, Medical, 908
X-ray centre, New, 895
X-ray examination of the brain, 220

YORKSHIRE Electricity Board: Power factor improvements, 148; Accident, 503; Consumers' money boxes, 652; Neepsend power link restored, 660; Commercial conferences, 661; Tariff questions, 945

ZANZIBAR: Saateni power station inaugurated, 1022

Printed in Great Britain at THE CHAPEL RIVER PRESS, Andover, Hants, and published by ELECTRICAL REVIEW PUBLICATIONS LTD., at Dorset House, Stamford Street, London, S.E.1.